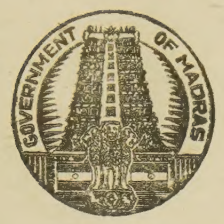

DETAILED ADMINISTRATION REPORTS OF SUBORDINATE OFFICERS OF THE DEPARTMENT OF AGRICULTURE MADRAS

FOR

1948–49

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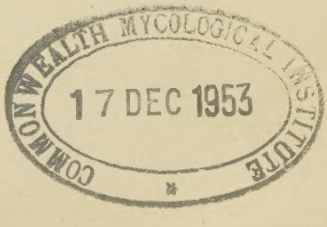

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ADMINISTRATION REPORT OF SUBORDINATE OFFICERS OF THE DEPARTMENT OF AGRICULTURE, MADRAS, FOR 1948-49.

DETAILED ANNUAL REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST FOR 1948-49.

I submit herewith my annual report for the year 1948-49.

Charge.—I remained in charge of the section throughout the year.

Staff.—Sri G. Ganapathi Ayyar and Sri K. Govindan Nayar, Assistant Agricultural Chemists, retired from service during the year. Dr. S. Kasinatha Ayyar was relieved on 23rd August 1948 to take up his new post as temporary Deputy Director of Agriculture, Tungabhadra Project, Bellary. Sri M. Sundaram and Sri C. Raghavendrachar, Upper Subordinates, were promoted to the gazetted rank. Sri B. S. Narasimha Ayyar was promoted as Assistant Agricultural Chemist in charge of the compost experiments to be carried out at selected Agricultural Research Stations. The gazetted post for the scheme was abolished with effect from 15th February 1949 and Sri T. S. Lakshmanan, one of the Senior Assistants, was put in charge of the scheme. The post of Soil Physicist has remained vacant since 1945.

As regards the subordinate staff, there were two additions in connexion with the scheme for reducing the manurial dose for potatoes in the Nilgiris.

The scheme for the investigation of 'black heart' in potatoes was ordered to be wound up with effect from 25th May 1949.

Transfer of animal nutrition work to the Veterinary Department.—As ordered by the Government all experiments connected with animal nutrition have been stopped. The work has been taken over by the Veterinary Department.

Award of Research degree.—Sri E. J. Verghese, Assistant, was awarded the degree of M.Sc. by the Madras University for his thesis "The Study of the Polysaccharides of Rice with special Reference to Quality."

The work of the section may, as in previous years, be conveniently reported under the three heads (i) Teaching; (ii) Analytical and Advisory; and (iii) Research.

I. Teaching.

With the transfer early in the year of Dr. S. Kasinatha Ayyar, Sri T. Rajagopala Ayyangar assisted by Sri M. Sundaram and three assistants was primarily in charge of the teaching. In addition, other members of my section with plenty of experience in their line were deputed to take up classes in particular branches of

Agricultural Chemistry. Thus Agricultural Geology was dealt with by Sri C. Raghavendrachar, Soils by Sri G. K. Chidambaram and Dairy Chemistry and Bacteriology by Sri M. Sanyasi Raju. The lectures on organic and inorganic manures were delivered by me and Sri D. V. Krishna Rao.

The number of lectures delivered and the practical classes held are given in the statement below :—

	Number of classes.	*Hours.*
B.Sc. (Ag.)—		
First year—		
Theory	50	50
Practical A and B Batches	53	106
Practical C and D Batches	53	106
Second year—		
Theory	63	63
Practical A and B Batches	25	50
Practical C and D Batches	24	48
Final year—		
Theory	138	138
Practical A and B Batches	73	146
Practical C and D Batches	84	168

Research students.—There were two research students on the rolls at the commencement of the year. One of them, Sri K. Bashyam, who was working on the magnesium nutrition of paddy, left early in the year to take up business. The other, Sri S. Ramarajan, has also left but after completing his work on the study of soil phosphates and writing up his thesis.

II. Analytical and Advisory.

Sri G. K. Chidambaram was in charge of the section. The analytical and advisory work constitutes the largest and one of the most important phases of the activities of the section. There has been considerable increase in the number of samples received for analysis in connexion with fundamental research on paddy, the nutritive analysis of improved strains of crops prior to their release to the public, the control of quality and price of manures, and irrigation projects, and reclamation of lands in connexion with the grow-more-food campaign. The services of the section were freely availed of by ryots and the general public, manure firms and officers of the Agricultural and other Government departments, especially Civil Supplies. Numerous queries received on matters relating to the improvement of soil fertility, manuring, irrigation waters and the feeding of livestock were answered. In spite of the all-round rise in the cost of living, there has been no increase in the rates of analysis fees and bona fide ryots are as before charged concessional rates amounting to one-fifth of the usual fees. The receipts by way of analysis fees amounted to Rs. 2,973 compared to Rs. 1,607 for the previous year. The English and Scottish Joint Wholesale Co-operative Society, Limited, Kozhikode, was the largest single contributor with Rs. 700 for the analysis of samples of soils

and tea leaves which work was undertaken to investigate the conditions responsible for healthy and weak bushes. Manure firms and ryots account for the rest.

The year opened with 991 samples in arrears. Two thousand, six hundred and sixty-five samples were registered for analysis during the year and the disposals numbered 2,535. As many of the junior assistants were still under training greater progress in clearing of the arrears was not possible. The classification of the samples analysed according to their nature and source of receipt is given in the statement below :—

	Agricultural department.	*Other Government departments.*	*Ryots and manure firms, etc.*	*Total.*
Soils	732	3	43	778
Manures	169	1	163	333
Foodstuffs and fodders ..	86	114	27	227
Plant products	1,015	..	14	1,029
Waters	60	2	9	71
Miscellaneous	64	29	4	97
Total ..	2,126	149	260	2,535

Among the various items of work carried out by the section for Government departments and the public the following may be mentioned :—

(*a*) In connexion with the intensive development of firkas to make them self-sufficient with regard to food and fodder, soil and water samples taken from alkaline areas in Musiri, Tirumangalam, Proddatur and Chicacole were analysed and based on the results of analysis suitable measures for their reclamation were recommended.

(*b*) Advice was given for the improvement of alkali lands in the colony for ex-servicemen in the Kattalai high level channel area at Neidalur in Tiruchirappalli district.

(*c*) Soil samples from the proposed ayacut of the Dharbhavari Agraharam tank in Badvel taluk were examined for their suitability for wet cultivation. The soils were found to be free from harmful amounts of water-soluble salts. The surface soils were sandy and of poor moisture retentivity while the sub-soils were loamy in texture. The soils were reported as suitable for being brought under wet cultivation. The application of liberal doses of bulky organic manures was recommended for improving the water-holding capacity of the soils.

(*d*) In connexion with the Goderu Project soil and water samples were analysed. The water was found to be excellent in quality. The soils were found to be clayey but free from harmful amounts of water-soluble salts and were reported as suitable for bringing under irrigation.

(*e*) To investigate the causes for the non-development of the ayacut under the Yellanur tank in Tadpatri taluk, four samples of soil and two well waters were analysed. The tank water had

previously been found to contain excessive amounts of sodium bicarbonate and carbonate. Analysis showed that the well waters were highly saline and also revealed the presence of harmful amounts of salts in the soil. In the absence of an abundant supply of good water to leach the salts out of the soil it was considered futile to attempt the reclamation of the area.

(*f*) Soil samples from the large block of alkaline land of the Ramakrishna Mission Students' Home Farm near Uttaramerur in Chingleput district were examined and gypsum treatment followed by flooding and drainage was recommended for the speedy reclamation of the area.

(*g*) It has been proposed to construct an anicut across the Bahuda river in Vayalpad taluk, Chittoor district. The water was found to be low in total solids and quite suitable for irrigation. Examination of soils from the ayacut revealed that the content of water-soluble salts was low but traces of sodium carbonate were present in some of the soils. The application of liberal doses of bulky organic manures was recommended for the improvement of such areas.

(*h*) In connexion with the opening of an agricultural farm attached to Dr. Alagappa Chettiyar's College at Karaikudi, soil and water samples were analysed. The soils were found to be very poor in all the three primary plant food elements and advice for building up the fertility of the soil was given.

(*i*) Messrs. Simpson & Co., Madras, have acquired large areas of waste land near Pudupakkam in Chingleput district, which they intend to put under vegetables to meet the needs of the canteens of their welfare centres and sell the surplus in the City. The assistance of the section was sought in respect of the improvement of an area of about 200 acres. Analysis indicated that the soils are sandy to sandy loam in texture and are deficient in all essential plant food elements including lime. Measures for the prevention of soil erosion and for building up the fertility of the soil were recommended. Mrs. Buck, the Welfare Director, has followed the advice with considerable benefit and with her enthusiasm and drive rapid progress has been achieved and several crops including vegetables have been raised with success.

(*j*) The East India Distilleries, Nellikuppam, sent four soil samples from an area where sugarcane failed. Analysis revealed that the soils were normal in all respects except that they were very open textured and deficient in available potash. In view of this and the large amount of potash removed per acre by sugarcane, the inclusion of potassic fertilizers in the manurial schedule was recommended.

In connexion with internal browning in sugarcane, soil samples from healthy and affected areas were received for examination from the same party. No marked differences in soil analysis were noticeable.

(*k*) Fourteen samples of green tea leaves from healthy and weak bushes and the corresponding surface soil samples from the Kalpetta group of estates were analysed for the English and Scottish Joint Co-operative Wholesale Society, Limited, Kozhikode, to determine the causes responsible for weak bushes. As has already been mentioned this party was the largest single contributor with Rs. 700 towards analysis fees. The leaves from healthy bushes were found to contain higher percentages of nitrogen, phosphoric acid and potash but lower amounts of lime and magnesia. The chemical analysis of the soils was not very helpful, no consistent differences between healthy and weak bush areas being noticeable in nitrogen, loss on ignition, lime and pH values in water and normal potassium chloride. Tea requires an acid soil with plenty of organic matter to provide a steady supply of nitrogen. Further it is a calcifuge and cannot tolerate more than a trace of lime. As no sub-soils were received for analysis full information regarding the soil conditions was not available. Indications have, however, been obtained that the soils from weak bush areas are, in general, characterised by higher content of lime and lower amounts of clay.

(*l*) Soil samples from Tindivanam, Tirur and Pattambi were analysed in connexion with their suitability for fruit growing.

(*m*) In connexion with the investigation of areca palm disease in South Kanara soil profiles in healthy and affected areas were examined but no marked differences in profile features and soil analysis were detected. The soils are typical laterities, characterised by good porosity and drainage. The trouble appears to be due to too close planting and inadequate manuring. Suitable recommendations were made. The Plant Protection Officer, Mycology, is conducting experiments on the lines agreed to at the meeting of the experts, the District Agricultural Officer, Mangalore, Deputy Director of Agriculture, Coimbatore and Sri Bhide.

(*n*) Two samples of well water of some interest were received for analysis. One was from Yellayapalayam in Kovur taluk, Nellore district. This is reputed to contain all the manurial ingredients necessary for raising vegetables and ragi, etc., year after year without the need for manuring. The water contains 240 parts per 100,000 of total solids, sodium chloride accounting for 108 parts. The water contained 25 parts of potash, 2·5 parts of nitrate nitrogen and traces of phosphoric acid. The high potash content of the water is noteworthy. It has been the experience in Visakhapatnam and certain other districts that water which contains small amounts of salts and is ' vatsa ' or insipid to taste is preferred to good water for raising vegetables. Probably sodium chloride in small amounts has stimulating effect on the crops.

At the instance of the Tahsildar, Dharapuram, a sample of mineral water reputed to possess medicinal properties was examined. The only noteworthy feature of the sample was its high content of calcium and magnesium sulphates.

(*o*) Samples of *Erthyrina indica* and *Glycena javanica* at various stages of growth were analysed for the Government Lecturing and Systematic Botanist. The plants were found to compare very favourably in feeding value with the best pasture grasses.

Among other interesting samples analysed for the Government Lecturing and Systematic Botanist may be mentioned the following :—

Trapa nuts (variously treated) which are used as food by the poorer classes in Travancore have been found to be rich in carbohydrates, have an oil content about that of rice and higher protein content than the commonly used cereals as will be seen from the analysis given below :—

	Raw kernels.	*Boiled and kernels removed.*	*Nuts fried and kernels removed.*
Moisture	10·36	10·49	8·89
Ash	2·13	1·89	2·09
Crude proteins	13·71	13·57	14·07
Ether extractives	0·91	0·85	0·96
Fibre	1·31	0·88	1·10
Carbohydrates (by difference)	71·58	72·32	72·89

A sample of *Mentha piperita* grown in the Nilgiris was found to have a low essential oil content compared to that of an average sample.

A sample of Eucalyptus leaves (*Rostratia*) received from the Agricultural Research Station, Pattukottai, was found to have a low content of essential oil compared to that of *Eucalyptus globulus* from the hill stations.

(*p*) One hundred and eighteen samples of soils, 16 of waters and 353 of grains and straws were analysed in connexion with fundamental research on paddy carried out by the Paddy Specialist.

(*q*) The nutritive analysis of improved strains of crops prior to their release, as directed in Government of India Circular, No. 702-P/46, dated 9th March 1946, communicated with Government Endorsement No. 18876 A-II/46-1, dated 21st March 1946, was continued. One hundred and twenty-four samples comprising 53 of pulses, 34 of paddy, 22 of millets and 15 of copra were analysed.

(*r*) Sixty-seven samples of straight and mixed fertilizers were analysed in connexion with the control of quality and price of manures as laid down in the Director of Agriculture's Circular G-1-2754/44.

(*s*) Thirty-five samples of village manures received from the southern districts were analysed in connexion with the collection of basic data regarding the quantity of village manures prepared in the districts.

(*t*) To encourage ryots to make greater use of the composts prepared in municipal areas for the grow-more-food campaign, composts prepared from city wastes were analysed for several

municipalities. The samples from Mangalore and Tellicherry, especially the former, were found to be the best as will be seen from the analysis given below :—

	Results on air-dry basis.	
	Mangalore.	*Tellicherry.*
Moisture	7·88	2·71
Loss on ignition	44·58	24·44
Insoluble matter	30·16	59·37
Nitrogen	3·09	1·23
Phosphoric acid (P_2O_5)	3·78	2·20
Potash (K_2O)	0·61	0·51

(*u*) Ninety-three samples of foodstuffs were examined for the Department of Civil Supplies. This includes flour samples for the detection of adulteration and six samples of semolina and cereals fumigated with methyl bromide. The residual bromide content of the fumigated samples was found to be quite low and well below the permissible limits and the foodstuffs were reported as safe for consumption.

(*v*) Twelve samples of cattle foods were analysed for the Animal Husbandry Department in connexion with the acceptance of tenders and the best in each category (groundnut cake, cotton seed, bran, etc.) recommended. One sample of rice bran received from the Veterinary Assistant Surgeon in charge of the scheme for the salvation of dry cows, Madras, was found to be very low in proteins and oil content and high in ash and insolubles, pointing to adulteration with sand and other materials.

(*w*) Five samples of fish meal and bone meal intended for use as poultry food were examined for the Fishery Marketing and Information Officer, Madras.

(*x*) Sixteen samples of transformer oils were analysed for acidity and the results reported to the Electricity Department. Advice regarding the method to be adopted was given and standard solutions for the work were supplied and of late this work is being attended to by the Electricity Department itself.

III. Research.

A. Soils.

1. *Studies on the origin and geo-chemistry of soils of the Madras Presidency.*—The study of the geo-chemistry of Madras soils which has been in progress for some years now has thrown important light on the chief characteristics of red, black and laterite soils. These studies were extended during the year to similar soils from areas hitherto unexplored and some interesting information has been obtained.

(*a*) *Black soils of Aziznagar area, South Arcot district.*—The advice of the section was sought in connexion with the improvement of the settlement lands and the opportunity was availed of to study certain interesting features presented by the black soils

of the locality. The area abounds in artesian springs and lignite deposits have been detected in it. Both red and black soils are met with, the former being less extensive and derived from Cuddalore formations. The black soils resemble in many respects the black-cotton soils of other areas. But they contain less of organic matter and are lighter-coloured and their outstanding feature is their remarkable depth. Borings put by the Industries Department are said to have gone down to 160 feet. The sandy fraction has been found to consist mostly of rounded quartz grains. Other minerals such as amphiboles, pyroxenes and titanium minerals usually present in the coarse fractions of black-cotton soils are absent. The profile features lead to the conclusion that the soils are sedimentary deposit, probably of marine origin and of cretaceous or Cuddalore age.

(*b*) *Red soils of Tirunelveli district.*—Some red soils of Tirunelveli district (Tirunelveli, Ambasamudram, Nanguneri and Tenkasi) which are characterised by very deep red colour were examined to see in what respects they differ from the red soils of other areas of the Presidency. These red soils appear to be derived in the main from garnetiferous acidic granites of the western ghats. Their deep red colour has been traced to the presence of biotite or iron bearing amphiboles or pyroxenes in the parent rock. The clay fractions are of the kaolinitic type, the silica-alumina and silica-sesquioxide ratios being of the same order as for other red soils. The red soil from Valliyur is lighter-coloured, being lateritic in nature. The mineral composition of the local rock formations is reflected in the sandy fractions.

(*c*) *Black soils of Jammalamadugu.*—Limestones of the Cuddapah-Kurnool formations have been found to give rise to black or red soils according as the clay impurity present is montmorillonitic or kaolinitic in nature. The non-calcareous clay material separated from Jammalamadugu limestone which gives rise to black soils has been found to be black. On treatment with the usual oxidizing agents (hydrogen peroxide, potassium permanganate or chromic acid) the organic matter gets oxidized and the clay becomes lighter (greyish white) in colour. The presence of easily oxidizable organic matter in the rock formations may be taken as an indirect proof that the rocks are of Cambrian or post-Cambrian period and not pre-Cambrian.

(*d*) *Black soils of Hasanur.*—The interesting observation has been made that black soils resembling in many respects the black-cotton soils of the plains occur even at high elevations and in mountainous topography as at Hasanur. They are very clayey, crack widely and the silica-alumina ratio of the clay fraction is high as in the case of black-cotton soils of the plains. They differ from the latter, however, in their lower pH (6·6) which is to be ascribed to their higher content of organic matter, being forest

soils. The black colour disappears on merely boiling with hydrogen peroxide, pre-treatment with acid required for black-cotton soils being unnecessary for this type of soil.

The results of examination of the clay fractions of the various soil types are given in the Appendix 1 (*a*) and 1 (*b*). Extraction of the clay separate with 2 per cent alkali and analysis of the filtered extract has given some interesting results. The black-cotton soils of the plains have about 2 per cent of alkali-solubles and the silica-alumina ratio is high, being greater than 3. The forest soils—both black and brown—of Hasanur show higher content of alkali solubles probably due to their high organic matter content and the decomposition of the secondary silicates by organic acids. The red soils are characterised by over 6 per cent of alkali soluble matter. The SiO_2/Al_2O_3 ratio is very low, pointing to the presence of free hydrated oxides of aluminium.

2. *Study of South Indian soils in relation to their colour and physical and chemical properties.*—This work has been taken up by Sri D. John Durairaj, Teaching Assistant, as the subject of his thesis to be submitted for the M.Sc. degree of the Madras University. To begin with, red and brown soils of different shades of colour have been taken up and the work will be extended to include other soil types.

The clay fractions of the soils selected for study were separated by the usual methods. The colour was determined, using 'The Dictionary of Colour' by Maery and Paul. Colour has three attributes, namely, value, hue and purity. For the purpose of correlating the colour with other properties it was found necessary to have a single figure for each colour. The purity was almost the same for all and hence it was left out. A single figure was arrived at by calculating the value of orange hue per unit value of yellow hue.

An attempt was made to effect a rough chemical franctionation of the clay constituents by using acid extractants of different strengths. The ease of extraction of the various clay constituents was in descending order as follows :—Ca, Na, Mg, K, Fe, Si, Al. Thus very dilute acids were found sufficient to extract Ca, but Al was very resistant and complete extraction could only be effected by using concentrated acids. The clay constituents extracted by the various treatments were expressed in terms of molecular proportions instead of mere percentages and molar ratios between various constituents or groups of constituents worked out. When mild acid extractants were employed a relationship was found to exist between the colour of the clay and the molar proportions iron oxide and the mono and divalent groups bear to each other and to the sum of the rest of the clay constituents. This relationship, however, does not hold good when more drastic treatment is employed.

3. *Investigation of the 'Cholam effect' and the changes in the physico-chemical properties of the black-cotton soil brought about by various crop rotations.*—The so-called 'Cholam effect' – the depressing effect of irungu cholam on the succeeding cotton crop—has been the subject of investigation by the Cotton Specialist in previous years. As the various explanations advanced to account for the phenomenon were not convincing, a new rotation experiment with 16 treatments and 4 replications was started last year at the Agricultural Research Station, Koilpatti. The analysis of the first round of 176 soil samples taken at the pre-sowing stage from 11 selected treatments was completed during the year. The second round consisting of post-harvest samples has just been taken up for analysis and it will be possible to draw definite conclusions only after completing this work. The determination of exchangeable bases in general and of sodium in particular in black-cotton soils bristles with difficulties on account of the presence of free calcium carbonate and of water-soluble salts, especially in the deeper layers and suitable methods had in the first instance to be worked out. For this reason and also on account of the fact that the extra assistant sanctioned for the work had to be given the necessary training in soil analysis, progress was necessarily slow.

4. *Reclamation of alkali lands in the Cauvery-Mettur Project area.*—There are hundreds of acres of alkali land awaiting reclamation in the Cauvery-Mettur Project area. With an assured supply of irrigation water of good quality, it should be quite easy to improve the lands. As a preliminary to this work, soil profile samples taken from typical alkaline lands round about Pattukottai were examined. The soils are free from excessive amounts of water-soluble salts but the degree of alkalinization or the percentage of monovalent bases to the exchange capacity is very high. The soils are sandy in texture and are deficient in all the chief plant food elements including lime. Based on soil analysis, a suitable site in the village of Seethambalpuram, 4 miles from Pattukkottai and by the side of the road to Arantangi was selected and the layout of the experimental plots to determine the most economical method of reclamation of the lands was done. The treatments include gypsum, lime and bulky organic manures, green manure, and molasses. An adequate system of drains has been provided and the application of soil amendments and flooding and drainage of the plots are just being taken up.

5. *Soil studies in the Wynaad tract in connexion with citrus disease investigations.*—The object of the study is to trace the conditions responsible for the poor growth and high mortality of orange trees in the area. As per orders of the Director of Agriculture, a scheme was drawn up jointly by the Government Agricultural Chemist, Government Entomologist, Government Mycologist and the Fruit Specialist and the technical programme approved by the Director of Agriculture in November 1948. The scheme includes the examination of soil profiles in healthy and affected areas, soil

moisture studies and chemical analysis of soils, under various cultural and manurial treatments. An orchard in Kalpetta was selected for the experiments and work started during the year.

The details of the programme pertaining to the work of this section are as follows :—

(1) Examination of soil profiles—depth, texture and chemical analysis of soils from the different horizons—from healthy and affected areas and also from the immediate vicinity of healthy and diseased trees.

(2) The effect of manurial treatments on moisture retention in the soil and the development of the root system.

(3) Physico-chemical studies of surface and sub-soils at different stages of plant growth. Periodical samples will be drawn and at least twice a year.

(4) Susceptibility of the soil to erosion and preventive measures for the same.

(5) Making good the deficiency of minor elements if necessary.

The cultural treatments, etc., that are being tried are given below :—

(*a*) Selection of 120 apparently healthy trees in an orchard (1) Pre-bearing area ; (2) Bearing area—

Total number of treatments in each area—6.

Total number of trees for each treatment—20.

(*b*) *Treatments.*—(1) Mamutty hoeing twice a year, once in June and again in September in accordance with the local practice ;

(2) No soil disturbance but weed growth to be cut ;

(3) Mamutty hoeing twice a year as in (1) above and manuring 10 lb. of groundnut cake plus ½ lb. of potassium sulphate or 20 lb. of wood ash plus 1 lb. of superphosphate per tree ;

(4) No soil disturbance but mulching of soil with dry leaves throughout the year.

(5) Four dadap cuttings to be planted on all the four sides of each tree and digging to be given all round the trees—once in June and again in September.

(6) Ten feet all round the tree to be planted with a cover crop like P. javanica or calopogonium and no cultural operation or fertiliser to be given.

Seventy-two soil samples—36 each from the bearing and pre-bearing areas—were drawn for analysis. The analysis of these samples is in progress. The data for 18 soils relating to the bearing area and representing different gradients are given in Appendix 2. An examination of the data reveals the following characteristics of the soils : (1) The clayey nature of the soils ; (2) The high proportion of sesquioxides ; (3) Deficiency of lime and available

P_2O_5 ; (4) High nitrogen and organic matter content of the surface soils. The soils from the lower gradients appear to contain higher percentages of nitrogen and organic matter.

Soil moisture estimation in soils representing each foot of soil down to 4 feet depth have also been taken up. When sufficient data have been collected the results will be examined and conclusions drawn.

B. Manuring and Plant Nutrition.

1. *Permanent manurial experiments.*—The old pernament manurial plots were laid out in the year 1908 and the new permanent manurials were started in 1924. The plots receive the same manurial treatment year after year, N, P and K in the shape of artificials singly or in various combinations or cattle manure and have been cropped intensively to emphasize the differential action of the manurial treatments. Due to lack of irrigation facilities, the old permanent manurial plots have for some years now been cropped only under rainfed conditions. For irrigating the new permanent manurials restricted irrigation facilities are available. The area is divided into two series—eastern and western—, the latter receiving basal dressing of cattle manure at 2,000 lb. per acre.

Owing to adverse seasonal conditions and very restricted irrigation facilities, the intensive cropping of these plots has become increasingly difficult in recent years.

O.P.M.—Taking advantage of the north-east monsoon rains, Cumbu Co.2 (seventy-ninth crop) was sown on 21st October 1948 and harvested on 22nd January 1949. Crop growth in the N+P, N+K+P and C.M. plots was better than in the others. The yields of grain and straw are given in Appendix 3. N+P gave the highest yield, followed by N+K+P and C.M. as close second best. The cumbu crop was made use of for foliar diagnosis studies.

N.P.M.—In the N.P.M. the thirty-seventh crop—Cumbu Co.3—was sown on 9th January 1949 and harvested in two stages on 19th April 1949 and 2nd May 1949. Crop growth was best in the N+P, N+K+P and C.M. plots of the eastern series. The N+P, N+K+P and C.M. plots were the earliest to mature. The phosphate fertilized plots gave well-developed ear-heads while the control and C.M.R. plots were the poorest. In spite of borer attack in the early stages and thrips in the later stages the yields (set out in Appendix 4) were very satisfactory. The grain yield averages 1,000 lb. per acre for the whole experimental area including the unfertilized plots.

The data relating to the permanent manurials up to the end of the previous year were statistically examined and the following conclusions emerge :—

(1) The treatment effects fall into two main groups—with and without P—, the former including N+P+K, N+P, K+P, P and cattle manure and the latter No manure, N, N+K, K and cattle manure residual.

(2) Generally speaking cattle manure has not proved definitely superior to N+P+K or even N+P, N+P+K has, in the case of ragi, given significantly better yields than cattle manure.

(3) It is worth noting that in all four crops extensively studied—cholam, ragi, panivaragu and wheat—the first four highest yields are given by the same treatments, viz., N+P+K, N+P, C.M. and P+K. Except in the case of ragi the differences found between the four treatments are not significant.

(4) The residual effect of cattle manure (C.M.R.) is very little and in most cases it is only as good as no manure.

(5) N applications alone are insufficient to improve yields, especially grain yields. In the case of fodder cholam, however, N by itself has given as good yields as C.M. or N+P or N+P+K.

(6) P by itself has shown an increase in yield over control only in the case of ragi and pani-varagu. Generally speaking N+P is a better combination than K+P. K by itself is ineffective in improving yields.

The chief practical recommendations that emerge out of these long continued experiments are—

(1) For maximum crop production either cattle manure or N+P+K is desirable. N+P also gives as good results and can therefore be recommended.

(2) Potassic fertilizers are not really essential for the cereal crops studied so far.

2. *Comparative efficiency of the commonly used green manure crops.*—Field experiments to test the relative merits of dhaincha, pillipesara, cowpea and sunnhemp as green manure for paddy were started in 1942 in the A Block, Wetland, Central Farm. Though the results have been very encouraging and consistently in favour of green manuring for paddy the data secured have been found to be somewhat erratic and no definite conclusion could be drawn as to the best green manure crop. This was traced to certain defects in the experimental area and to remedy these defects another set of plots was laid out in the D block last year. Superphosphate at 200 lb. per acre was also applied to the green manures which are raised in situ and ploughed into the soil. The experiments were conducted on the same lines as in previous years and were designed to throw light on the following points : (1) Green weight, dry weight, decomposability, leaf to stem ratio and nitrogen content of the green manures ; (2) Effect in increasing paddy yields ; and (3) Effect on the nitrogen content and ferility status of the soils.

The relevant data are presented in Appendices 5 to 21 and remarks will be confined to certain salient features noticed.

(*a*) *Green weight dry matter, etc., of green manure crops—A. Block.*—The growth of all the green manure crops was excellent

and the yield was more than double that of the preceding year. Among the various crops the difference in yield was not appreciable (vide Appendix 5).

D Block.—Dhaincha gave the remarkably high yield of 30,895 lb. per acre. The growth of cowpea and pillipesara was similar to that observed in the A Block. The sunnhemp crop which was of the short duration variety was poor.

Pillipesara and cowpea were more succulent and twice as leafy as dhaincha or sunnhemp.

With the exception of pillipesara the N content of the green manure crops was higher for the A Block samples than for the D Block. Dhaincha and long duration sunnhemp yielded more dry matter and N than the other green manure crops.

As regards decomposability cowpea and pillipesara are the best, dhaincha the worst and sunnhemp comes in between. There is a positive correlation between decomposability, leaf to stem ratio and succulency.

(*b*) *Effect on paddy yields—A Block.*—The superiority of the plots receiving green manure was quite evident within three weeks after transplanting. The treated plots have given increases in grain yield ranging from 82 to 92 per cent and 178 to 240 per cent in respect of straw as will be seen from the figures given below :—

	Per cent increase over control.	
	Grain.	*Straw.*
Dhaincha	92·5	240·0
Sunnhemp (long duration)	83·6	236·5
Pillipesara	92·3	235·8
Cowpea	82·3	178·3
Control	1,893 lb. per acre.	1,648 lb. per acre.

Conclusion.—Grain—Dhaincha, Pillipesara, Sunnhemp, Cowpea. Straw : Dhaincha, Sunnhemp, Pillipesara, Cowpea. The treated plots have given grain yields comparing very favourably with those of the best lands in the deltaic areas.

D Block.—The data relating to the D Block experiments are given below :—

	Per cent increase over control.	
	Grain.	*Straw.*
Dhaincha	37·7	67·5
Sunnhemp (short duration)	26·6	35·2
Pillipesara	28·0	70·4
Cowpea	19·6	58·6
Control	2,729 lb. per acre.	2,780 lb. per acre.

Conclusions.—Grain—Dhaincha, Pillipesara, Sunnhemp, Cowpea, Control. Straw : Pillipesara, Dhaincha Cowpea, Sunnhemp, Control.

(c) *Effect of green manuring on the fertility status of the soil.*—Surface and sub-soil samples drawn after the harvest of paddy were examined for N, loss on ignition, microbial population and activity and the results are set out in Appendices 14 to 21. The dhaincha plots in the A Block have nearly twice the N content of the controls. This being the first year of trial, such striking differences are not noticed in the D Block.

From the data obtained so far the following conclusions may be drawn : (1) under normal conditions, with an adequate supply of water, dhaincha is the best green manure crop from the point of view of dry matter yield, nitrogen added, increased yield of paddy and the building up of soil fertility. It is fairly hardy to drought and can stand water logging. The chief drawback is its slow decomposability but during the growth of the paddy crop it becomes progressively available. Pillipesara is the next best, its chief advantages being its succulency and easy decomposability. These advantages are well seen in droughty seasons. Its chief drawbacks are its very slow growth during the initial stages, thus permitting weeds to smother it and the abundant supply of water required for its luxuriant growth. Cowpea and long duration sunnhemp come next and short duration sunnhemp is the poorest. Considerably higher yields of both grain and straw could be secured by green manuring paddy crops.

3. *Studies on green manuring of paddy.*—An account was given in the last annual report of the pot culture experiments that were carried out to settle the much disputed question as to whether green manures applied to paddy have direct manurial value as claimed by Joachim and Kondiah, or are only of indirect value, their main function being to promote the activity of the algael film and facilitate the aeration of the roots of paddy as postulated by Harrison and Ayyar. Periodical analysis of drainage waters revealed considerable reduction in the content of ammoniacal N with plant growth. Nitrites and nitrates were not detected in the drainage waters. Indications were obtained that the supply of readily available N was the main factor influencing the growth and yield of paddy.

The analysis of the soils and plant materials at the end of the experiment was done and the nitrogen balance was worked out for each pot, that is to say, the nitrogen in the soil at the start, in the seedlings and the manure applied was balanced against that recovered in the plant material, drainage water and the soil at the end of the experiment. From the results presented in Appendix 22 it will be seen that there is negative balance in the case of the control (unmanured pots) while the manured pots show an actual gain in nitrogen. It is therefore to be inferred that the nitrogen of the green manure is not lost but is actually made use of by the plant and thus green manure has direct manurial value.

In the course of the experiments it was also observed that green manure induced earliness in flowering and promoted growth

characteristics such as tillering, mean height of plants, etc., comparing favourably with ammonium sulphate in this respect. In its effect on paddy yield green manure was about two-thirds as effective as ammonium sulphate on equivalent nitrogen basis.

Pot culture experiments with nitrogen starved soil from the O.P.M. were repeated on the same lines as in the previous year. In addition to the treatments of last year combinations of green manure and ammonium sulphate and uncropped pots were also included in the study, the complete picture of the treatments being as follows :—

1 No manure—Control—Uncropped.

2 Do. Cropped.

3 Green manure 5,000 lb. per acre—Uncropped.

4 Do. Cropped.

5 Ammonium sulphate to provide nitrogen equivalent to 4—Uncropped.

6 Ammonium sulphate to provide nitrogen equivalent to 4—Cropped.

7 Green manure 10,000 lb. per acre—Cropped.

8 Ammonium sulphate on equivalent nitrogen basis to 7—Cropped.

9 Green manure as in 4 plus ammonium sulphate as in 6—Cropped.

Superphosphate at 200 lb. per acre was applied as basal dressing.

The data relating to these experiments—the results of periodical analysis of drainage waters, the yields of paddy grain and straw, etc., are given in Appendices 23 and 24.

The analysis of drainage waters has shown that only a fraction of the total N is present in the ammoniacal form. Nitrites and nitrates are absent. Forms of N other than nitrites, nitrates and ammoniacal N appear to play an important role in the nutrition of paddy.

The N balance was worked out for each pot separately and the results are in general agreement with those of last year.

As regards grain yield all the manured pots gave considerably higher values than the control. The double dose of ammonium sulphate was the best, green manure plus ammonium sulphate being second.

In addition to the above experiment pot culture trials with typical paddy soil from the D block, wet lands were carried out. The analysis of drainage waters was not done in this case and the N balance could not therefore be worked out. Considerable

difficulty was experienced in drainage. The analysis of soils at the end of the experiment showed an increase in nitrogen content, especially in the pots receiving green manure.

Field trials on the same lines as above were carried out in the D block and the results are presented in Appendix 26. Statistical examination of the data has revealed that though considerable increases in grain yields have resulted from manuring the grain yields are not significant. The double dose of ammonium sulphate gave the best result followed by the combination of single dose each of green manure and ammonium sulphate. The straw yields are, however, significant. Green manure appears to be about two-thirds as effective as ammonium sulphate on equivalent N basis.

4. *Green leaf manures.*—The stem to leaf ratio, moisture and nitrogen in stem and leaf and decomposability for some of the commonly used green leaf manures were given in the last year's report. This year *Cassia Siamia*, *Thespesia* and *Delonix* were also included in the study and the nitrifiability also examined. The results are presented in Appendix 27. *Cassia Siamia* and *Delonix* are characterized by high proportion of stem to leaf and their nitrifiability is poor. The decomposability was highest in the case of *Thespesia*. The succulency and nitrogen content afford the best index of the usefulness of green leaf manures. Judged by these criteria the value of the commonly used green manures in descending order is as follows :— *Glyricidia*, *Calotropis*, *Pillipesara*, *Thespesia*, *Croton sparsiflorus*, *Delonix*, *Pungam*, *Cassia Siamia*.

5. *Manurial and rotational experiments on potatoes at the Agricultural Research Station, Nanjanad.*—In view of the lateritic nature of the soils of the Nilgiris, the high proportion of iron and alumina present, low pH and deficiency in lime, soluble phosphatic fertilizers like superphosphate are rendered insoluble in combination with iron and aluminium and become unavailable to the crops. Further, the slopes on which potato is grown coupled with high rainfall renders the washing out of the soluble manures easy with the result that high doses of manures have to be applied to secure good yields. Experiments designed to cut down the manurial bill have recently been initiated at the Agricultural Research Station, Nanjanad. Indirect phosphate manuring by application of phosphate to the leguminous green manure (lupin) preceding the potato has been included in the study to find out if it would be possible by this means to minimise the fixation of phosphate by iron. The experiments are in progress. Soil samples from the plots were drawn and analysed.

6. *Silico-phosphate experiments.*—As has been stated under paragraph 5 above the poor availability of phosphates in acid soils is an established fact and heavy and uneconomic doses of phosphatic fertilizers have to be applied to such soils to secure

good yields of crops. It has been pointed out by several investigators that silicates help to increase the assimilation of phosphorus from soils. To examine how far the application of silicates and of phosphates in the form of silicophosphates (basic slag, etc.) would help to reduce the dose of phosphatic fertilizers required, especially in the case of acid soils, pot culture experiments were started with soil from the Agricultural Research Station, Nanjanad. There are sixteen treatments involving the use of sodium silicate, basic slag, superphosphate and 1 : 2 mixture of super and sodium silicate alone and also in combination with lime, organic matter and lime and organic matter. The soils are maintained at 50 per cent of their moisture-holding capacity and samples are being periodically drawn and anlysed for available phosphoric acid by Dyer's 1 per cent citric acid method.

7. *Compost experiments.*—In pursuance of the compost scheme sanctioned during the year field trials are being carried out at selected Agricultural Research Stations to determine the relative merits of night soil and farm waste composts compared to farmyard manure.

Experiments with night soil compost are being conducted at Anakapalle, Samalkot, Guntur, Tirur and Coimbatore. Experiments with composts prepared out of farm waste are in progress at Palur, Pattambi, Aduthurai and Maruter.

The crops on which these are to be tried are given below :—

Anakapalle	Paddy and Sugarcane.
Samalkot	Paddy and Plantains.
Guntur (Lam Farm) ..	Variga and Chillies.
Tirur	Paddy.
Coimbatore (Central Farm).	Paddy, Sugarcane, Ragi and Cholam.
Aduthurai	Paddy.
Palur	Cumbu, Ragi and Sugarcane.
Pattambi	Dry paddy.
Maruter	Paddy.

The scheme has been sanctioned for four years. The cropping programme to be followed at the different centres was prepared and sent to the concerned officers. Manure and soil samples relating to the experiments were analysed.

The progress of work at the various centres is indicated below :—

Anakapalle.—Compost prepared by the municipality has been used for this year's experiments on sugarcane. For the subsequent crops arrangements have been made to have it prepared on the farm itself. Sugarcane was planted on 13th April 1949.

Samalkot.—Compost got from Peddapuram Municipality was used for the plantain crop. Sugarcane which had originally been included had to be deleted from the list of crops to be tried at

this centre for want of space. The compost manure as prepared by the municipality was found to be not up to the standard. The preparation of manure needed for the subsequent crops will be carried out in the municipality but under the supervision of the Superintendent, Agricultural Research Station, Samalkot.

Guntur (*Lam Farm*).—Compost preparation was taken up only in April 1949 and the manure may be ready for the next crop of chillies and variga.

Tirur.—Compost from Tiruvellore Municipality will be used for first crop of paddy. For the subsequent crops manure prepared under the supervision of the Superintendent will be applied.

Coimbatore (*Central Farm*).—Compost manures prepared in the Central Farm are being used for the experiments. Cholam was harvested towards the end of June this year. Experiments with ragi and sugarcane are in progress.

Aduthurai.—Experiments have been started on paddy in the Kuruvai season. Compost prepared out of farm waste has been applied.

Pattambi.—Modan (dry) paddy was sown in June 1949.

Palur.—Sugarcane was planted on 30th March 1949. Experiments with cumbu and ragi are scheduled to commence this month.

Maruter.—Compost prepared out of farm waste is being applied to the paddy crop which will be raised this month.

8. *Studies on foliar diagnosis.*—This work aims at the study of the relationship of yields to nutrition of crop plants grown in differently fertilized plots as indicated by the periodical analysis of leaves of the same physiological or metabolic age. The essential points of the method are that leaves at a definite point on the plants are selected as the material to be analysed. Leaf samples are taken at the chosen points on four or more occasions during the growth cycle of the plant and are analysed for N, P, K, Ca and Mg according to approved methods of analysis. Concepts of intensity of nutrition and N-P-K units are used to interpret the mineral composition of the dried foliage of the crop. The former is the sum of the percentages of N, P_2O_5 and K_2O in the leaf at the time of sampling and the latter (N-P-K unit) is derived by converting the percentage composition with respect to N, P_2O_5 and K_2O into milligram equivalents and determining the proportion that each of the values bears to the milliequivalent total. The NPK equilibria are expressed graphically with the aid of trilinear coordinates. The diagram of the plant suspected of deficiency of some plant food element is compared with that of the healthy plant in which all the elements are present in optimum.

The first of the series of crops selected for the study was cumbu grown in the old permanent manurial plots. Fourth leaf samples of the crop from the differently fertilized plot were collected at fortnightly intervals. Forty samples in all were collected and analysed. The data obtained have been taken up for the interpretation of the results.

The work will be continued with other crops like maize, tobacco, cholam to be raised in the permanent manurial plots in the ensuing seasons.

9. *Improvement of marginal lands.*--Following the experience in the T.V.A. experiments aimed at improving the fertility level of marginal lands were started in Tirunelveli district. The method consists in growing legumes inoculated with their specific root nodule bacteria and with the application of phosphatic fertilizers and, after utilizing the first cutting as green fodder, ploughing them in, in order to supply plant food and organic matter to the succeeding crop. The cumulative effect of such practice for three to five years, it is expected, will improve the soil. Two sets of experiments are in progress, one on ryots' fields and the other at the Agricultural Research Station, Koilpatti. In the former only crop yields are being recorded while in the latter the soils are analysed to determine the improvement in the organic matter and nitrogen status of the soil.

The experiments on ryots' lands are being conducted at Tirunelveli, Ambasamudram and Nanguneri. The BAB plan was adopted at the various centres. The B plots were treated with superphosphate while the central plot served as control. The legume started promisingly but due to the failure of the seasonal rains and prolonged drought withered and no cereal crop could be grown.

As regard the same experiments at the Agricultural Research Station, Koilpatti, the green manure crop was ploughed in. The analysis of the surface and sub-soils was carried out both at the start and at the end of the experiment. The results given below reveal slight improvement in the organic carbon content and base-exchange capacity of the top soil. There has practically been no change in the N content.

	At the start.		*After the incorporation of green manure.*	
	Top soil.	*Sub-soil.*	*Top soil.*	*Sub-soil.*
	PER CENT.	PER CENT.	PER CENT.	PRE CENT.
Loss on ignition	4·90	3·78	4·43	4·13
Total P_2O_5	0·071	0·033	0·068	0·052
Available P_2O_5	0·023	0·003	0·036	0·003
Organic carbon	0·21	0·17	0·24	0·18
Total nitrogen	0·036	0·037	0·036	0·035
Base exchange capacity (miiligram equivalents per 100 gm. of soil.)	26·26	15·93	27·05	14·13

Cumbu was grown in the plots and the yield data are awaited from the Superintendent, Agricultural Research Station, Koilpatti.

10. *Studies on organic matter decomposition in black-cotton soils—Field experiments at the Agricultural Research Station, Siruguppa.*—These experiments were started some years ago at the Agricultural Research Station, Siruguppa, to follow the nature and decomposition of green manure (Sunnhemp) applied at 10,000 lb. per acre under irrigated and dry conditions and in presence and absence of crops. The ultimate object of the investigation was to evolve a suitable method for enriching the humus and N content of the black-cotton soils of the Tungabhadra Project to be brought under irrigation. Seventy-two soil samples relating to the experiments were analysed for carbon and nitrogen and the C : N ratio worked out. From the data given in Appendix 28 the following conclusions may be drawn : (1) There has been slight improvement in the N and organic matter of the first foot samples, fallow and cropped, and dry as well as irrigated. There is very little difference in the C : N ratio between the treated and untreated plots. The ratio is in all cases very high (24-28) and nearly double that for normal soils (10 –15).

C. Plant Physiology,

Sri T. R. Narayanan was in charge of the Plant Physiology work reported below :—

I. *Nutritional and physiologiacl experiments on* (*a*) *Paddy*—(i) *Fertility studies in the Central Farm Wetlands.*—The results of growth measurements and chemical analysis of paddy plants (variety Co. 3) sampled from the four Wetlands Block, B, L, C and F at different stages of growth are presented in Appendix 29. The yields recorded in 1948 season are compared with previous years' yields in Appendix 30 from which it would be seen that the 1948 yields were not in line with the previous 25 years' averages noted for the 4 blocks B, L, C and F. It is however interesting to note that the same type of relation appears to exist between the 25 years' averages and soil nitrogen and between the current year yields and the plant nitrogen.

The data given in Appendix 30 seem to indicate that nitrogen content at the seedling stage could serve as an index of subsequent yield.

(ii) *Spraying with trace elements on paddy.*—In order to confirm the indications observed in a similar experiment conducted in 1947, spraying trials were carried out with copper, zinc and manganese sulphates, both singly and in combination, on 27th September 1948 in H-Block of the Central Farm Wetlands on a long duration paddy variety X. 3840, one month after transplantation. Higher concentrations of the salts were used this year and each treatment was replicated six times instead of four as in 1947. The results are given in Appendix 31.

Three treatments, namely, $ZnSO_4$, $MnSO_4$ and all three salts together, have given increases in grain yield that are significantly better than the control. It is worth noting that the same three treatments were better than control in the previous season also although the differences did not attain statistical significance. It would seem desirable to continue the studies for one more year using still heavier doses of the same salts in addition to the same doses as this season.

(iii) *Pre-soaking studies on paddy.*—A pot culture experiment was started on 28th February 1949 with a short duration paddy strain Co. 13 to verify if the growth and yields could be increased as claimed by Roach and Roberts, 1949 in the case of wheat, oats and barley, as a result of pre-soaking the seed in phosphate solutions amounting to about 30 per cent of the weight of seed taken. The general method was as follows: A short duration variety of paddy, viz., Co. 13, was chosen as suitable for sowing in February. The seeds were soaked in one-third of their weight of solution, care being taken to see that all the liquid was absorbed by the seed within 24 hours. The seeds were then air-dried to the original weight by spreading in a thin layer, with occasional turnings to ensure uniform drying. The seeds were sown in 10 × 10 inches glazed pots holding about 30 pounds of soil at the rate of two seeds per hole and twenty-five holes per pot. After germination the plants were thinned out in the three stages before flowering so as to have a uniform stand of ten palnts per pot for flowering and yield records. The results are presented in Appendix 32 and would seem to indicate that by soaking the seed in tri-potassium phosphate solution, the subsequent grain yield could be increased by nearly 40 per cent over the control. Other forms of potassium phosphate, namely, the mono and the di-potassium salts seem to have no appreciable effect on grain or straw yields. Pre-soaking in two strengths of indole acetic acid has also increased grain yield, though to a lesser degree than by tri-potassium phosphate. A combination of phosphate soaking and vernalization was found in this experiment at any rate, to be ineffective in improving grain or straw yields, although the average tillering appeared to be improved thereby. No difference could likewise be found in flowering earliness between any of the treatments and the control.

Chemical examination of grain and straw from pre-soaked and control plants has been taken up to see if any difference exists in the phosphate content or in other elements. These results will be submitted in due course later on.

(iv) *Vernalization studies on paddy.*—Studies were continued during this year also, on the effect of different vernalization treatments on different paddy varieties, in the field as well as in pot cultures. Ten varieties were tried in pot cultures and seven of these ten under field conditions at the Paddy Breeding Station; all in four replications of five treatments including untreated controls. The results of 1948 season are given in Appendix 33 and a summary of the three years' results in Appendix 34.

The main conclusions that can be drawn from these data are as follows :—

Certain varieties are noticed to be more responsive (and flower earlier than controls) to extra light, e.g., ADT. 3, and Co. 21, while others like AKP. 8 and MTU 7 are induced to flower earlier by extra darkness. It was also noticed that when flowering is very much earlier, other features like plant height and yield are correspondingly reduced.

In almost all the varieties studied so far, it seems possible to obtain a distinct increase in grain yield by some particular vernalization treatment but this optimum treatment is different for different strains (vide Appendix 34). Thus ADT. 3 and PTB. have shown the maximum increase after vernalization for 14 days, whereas a similar short duration variety Co. 21 gave the best response with extra light for seven days. Three other short duration varieties that were tried for the first time this year, viz., Co. 10, Co. 23, and T. 672 appear to be very much improved in grain yield by vernalization for 7 days under continuous light, but a longer duration of vernalization does not seem to be beneficial.

It is worth noting that the variety GEB 24 has consistently given the best response to vernalization during all the three years it has been studied and further trials on a larger scale under field conditions in a number of different centres would seem worth while. AKP. 8 is also another responsive strain which may be taken up for further trials in the Northern Circars.

(*b*) *Other crops*—(1) *Deficiency studies on ragi.*—A pot culture experiment was conducted on ragi variety Co. 1 with the object of studying the visual symptoms and analytical differences caused by deficiencies of N, P, K, Ca, S, Fe and Mg. The details of results from the experiment on ragi are summarized in Appendix 35.

It will be noted from Appendix 35 that the tillering and weight of shoot material are both very much reduced by the absence of the elements N, P and K. Plant height is also less than in control but not to the same degree. A deficiency of sulphur seems to have an effect of making the plants taller though not significantly so, but it is clear these plants are really poorer in growth as the tillering and shoot weight are both very much poorer than in control.

Foliar symptoms were distinct in this crop only in the case of the three major elements N, P and K ; in the other deficiencies they were not sufficiently clear-cut to be of diagnostic value.

(2) *Boron on sweet potatoes.*—The field trial started in 1948 for testing the effect of different doses of borax on the yield of sweet potatoes was continued for a second year in F. No. 52 B. and the results are given in the Appendix 36.

It would be noted that 40 lb. of borax had the effect of increasing the tuber yield by nearly 23 per cent but higher doses depress the yields. The results have however to be confirmed by one more trial, as the yields were in general very much below normal and widely variable. The size of tubers was noted at harvest time as being distinctly larger in the 40 lb. borax treatment than the controls.

In the previous year's experiment on sweet potatoes, where 10, 20 and 40 lb. of borax per acre were compared with untreated controls, there was an increase of 24·7 per cent in tuber yield as a result of applying 40 lb. borax, but the difference was not statistically significant.

(3) *Boron on Lucerne.*—Boron is reported to be very beneficial to lucerne in various parts of America and elsewhere; this was sought to be verified for South Indian conditions by laying down an experiment in the Central Farm in F. No. 59 A, using three levels of borax, 10, 20 and 40 lb. per acre in randomized plots of 0·39 cents net area replicated five times. The first cutting was taken on 16th January 1948 and the experiment was continued till November 1948, taking twelve cuttings at intervals of about a month. The results are summarized in Appendix 37.

As the differences were not sufficient to be statistically significant, a second trial has been laid down in F. No. 59 A, with heavier doses of 40, 80 and 120 lb. of borax per acre in six replications of 1½ cent plots. Borax was applied on 30th October 1948 and lucerne sown on 30th November 1948. Five cuttings have been taken so far and as the experiment is still in progress, the results will be commented upon in the next report.

(4) *Pre-soaking studies on groundnut.*—A sand culture experiment was carried out with groundnut, on the same lines as described for paddy in I (*a*) (iii). In addition to two levels 10 and 20 per cent of the three potassium phosphates, calcium phosphate was also included in 10 and 20 per cent solutions. It was then found that all these salts were too toxic at 10 and 20 per cent strengths and none of the seeds germinated. A second trial was therefore carried out with 2 and 5 per cent solutions, and with unsoaked seed to serve as control. The details of the experiment as well as the results obtained are summarised in Appendices 38 and 39.

Conclusions.—The plants in treatment 4 (soaking in 20 per cent calcium phosphate solution) seem to be better than control in vigour of growth as reflected in plant height, pod number and pod weight and also in the total weight of plant material, but the differences attain statistical significance only in the case of plant height and pod number. The yield of pods is not improved significantly.

Experiment II.—As it was found that 10 per cent and 20 per cent solutions of potassium phosphate suppressed germination in this crop, lower concentrations were tried in a second experiment; the results of which are given in Appendix 39.

In this experiment a very distinct and marked superiority was evident even from early stages in the plants from treatments (1) and (2) where the seeds had been soaked in 2 per cent and 5 per cent solutions of potassium dihydrogen phosphate. This superiority was maintained up to harvest stage and was apparent not only in vigour of growth and depth of green colour in the foliage, but in the yield of pods also. For instance with 2 per cent solution, there is an increase of 95 per cent in mean pod weight and with 5 per cent solution, the increase over control is as much as 102·6 per cent. It would thus seem as if groundnut is benefited best by presoaking in monopotassium phosphate, unlike paddy where the maximum response was observed with tri-potassium phosphate. This is in line with the observations of Roach and Roberts who found that "there was a particular compound which is the best for each of the cereals." For oats, tripotassium phosphate was the best, while wheat gave the best response with a 15 per cent solution of potassium dihydrogen phosphate and barley required a 17 per cent solution of dipotassium phosphate.

It is proposed in view of the promising nature of the results obtained in these preliminary studies, to continue the work during the next season also, in pots as well as under field conditions.

(5) *Pre-soaking studies with Cowpea.*—A similar trial was conducted in sand cultures with cowpea (*Vigna Catjang*), including the following 12 treatments :—

(1) Distilled water once ;
(2) Do. twice ;
(3) KH_2PO_4 —10 per cent solution.
(4) Do. 20 do. do.
(5) K_2HPO_4 —10 do. do.
(6) Do. 20 do. do.
(7) K_3PO_4 —10 do. do.
(8) Do. 20 do. do.
(9) $CaHPO_4$ 10 do. do.
(10) Do. 20 do. do.
(11) Dry seed (control).
(12) Soaked 24 hours and sown wet.

The results will be summarized later after completing the harvest and analysis.

II. *Black Heart in potatoes.*—A disease known as black heart in potatoes asumed serious proportions during the war years when potatoes had to be stored and sent in large wagon loads by rail from the Nilgiris to Ranipet for dehydrating purposes for military consumption. The chief symptom of the disease was a blackish discolouration in the heart of the potato tuber, set off sharply against the surrounding creamy-white healthy tissues as an oval

or heart shaped patch. Often external symptoms are also visible in the shape of moist areas on the surface that subsequently turn brown or black, but usually the disease is evident only when the tubers are cut open. This feature naturally makes for serious losses in marketing as affected tubers are unsaleable. No fungal or bacterial organism is involved in causing this disease which is due to a physiological breakdown of the tissues brought about by overheating and lack of ventilation during storage. Large tubers are more prone to develop black heart than small ones, because the central regions of the larger tubers do not get sufficient access to air.

Arising out of the war-time aggravation of this storage disorder and since potatoes form even in peace time an important food crop, an investigation was started (as a one-year scheme of research) for determining the factors inducing the disorder and for devising suitable preventive measures. Work was started on the scheme in June 1948 after formal sanction was received from the Government and continued till the 25th May 1949 when the scheme was ordered to be terminated.

Material and methods.—The variety Greatscot was used through out as it is the most popular type grown in the Nilgiris. Tubers were obtained from the Nanjanad Research Station in periodical consignments for storage under combinations of the following environmental factors :—

Temperature—30°C., 35°C., and 40°C. and ordinary laboratory temperature.

Humidity—(1) Ordinary uncontrolled humidity ; (2) Saturated with water vapour ; (3) Completely dry atmosphere.

Aeration—(1) Ordinary air ; (2) Oxygen free atmosphere ; (3) Continous aeration at 40°C. by aspiration.

The tubers were first disinfected by dipping in 0·5 per cent mercuric chloride solution for 30 minutes. After drying they were given an anti-sprouting dip in a solution of the methyl ester of alpha-naphthalene acetic acid at 100 mgms. per kilogram of tubers. Samples of tubers were examined at weekly intervals for symptoms of black heart and the starch, sucrose and hexose contents of each sample were also determined to see if any relation existed between the incidence of disease and the relative proportion of these carbohydrates in the tubers. A storage period of up to 16 weeks was arranged for in each of the different treatments. The results are given below :—

(*a*) *Loss of weight in storage.*—Under ordinary conditions of temperature aeration and humidity, there was a progressive loss of weight with duration of storage, from 0·4 per cent in the first week to 17 per cent in the tenth week. After the tenth week the loss of weight was not very consistent. The reason for the irregularity is not very clear and needs further study for elucidation.

Under saturated conditions of humidity, the loss of weight was negligible, being only 0·09 per cent by the sixth week under a completely dry atmosphere the loss of weight as would be expected was much more rapid increasing from 1·2 per cent in the second week up to 9·9 per cent by the sixth week of storage.

(*b*) *Development of black heart*—

(1) Ordinary conditions (i.e., temperature 26-29°C., humidity 60-82, R.H.) ; and normal aeration).	No black heart symptoms were evident up to 11 weeks ; but a few tubers got affected after the twelfth week.
(2) Temperature 26-29°C.—*Dry atmosphere.*	In one batch, black heart symptoms were evident within one week. In a second batch the symptoms were found only after four weeks in storage. In a third batch, black heart symptoms were seen in the fourth week.
(3) Temperature 30°C.—Dry atmosphere.	Black heart developed by the fourth week.
(4) Temperature 35°C.—Dry atmosphere.	Black heart developed by the fourth week.
(5) Temperature 40°C.—Dry atmosphere, continuous aeration.	Black heart developed in one week itself.
(6) Saturated atmosphere—Laboratory temperature (26–29°C.)	No black heart symptoms were apparent up to eleven weeks in storage.
(7) Saturated atmosphere—Temperature 30°C.	Black heart symptoms were evident by the second week.
(8) Saturated atmosphere—Temperature 35°C.	Black heart symptoms were evident by the third week.
(9) Saturated atmosphere—Temperature 40°C.	Black heart symptoms evident by the second week.
(10) Saturated atmosphere—Temperature 40°C. continuous aeration.	Black heart evident in the first week itself.
(11) Oxygen-free atmosphere at laboratory temperature.	Black heart develops by the second week and in addition rapid rotting of the tubers occurs.

(*c*) *Chemical analysis.*—(i) *Reducing sugars*—It was found that the variations with storage time, in the content of reducing sugars were very closely similar between treatments (1) and (6), i.e., between ordinary conditions and saturated atmosphere. In both these treatments the tubers were free of black heart symptoms until the twelfth week in storage. In a dry atmosphere (treatment 2) where black heart symptoms became apparent by the first week itself the hexose sugar content was distinctly lower than in treatment (1) and (6) where the disease was absent up to the twelth week. At this stage it is not possible to conclude how far black heart development is related to a low content of hexose sugars as cause and effect. Further study is necessary to clear this point.

(ii) *Sucrose.*—Tubers stored in a saturated atmosphere showed a higher sucrose content than those kept under ordinary conditions of humidity but the sucrose content of tubers kept in a dry atmosphere and those in an oxygen-free atmosphere were not appreciably different from that in tubers under ordinary humidity and aeration.

(iii) *Starch.*—No definite relationship could be found between strach content and different conditions of storage.

Another interesting fact noted in the course of the investigation was that the popular Nilgiri vatriety Great scot seemeed to be, at least under Coimbatore conditions, somewhat more resistant to black heart than other varieties studied elsewhere in the colder countries of the West.

In large-scale practice, potatoes can be kept free of black heart during storage if there is adequate provision for free ventilation and avoidance of overheating. To assure free circulation of air, the tubers should not be piled up into solid heaps ; even if the temperature is below 70°F.

III. *Viability tests.*—A sample of indigo seed was received from the Agricultural Demonstrator, Nellore, on 29th November 1948, under instructions from the Director of Agriculture for testing the germination capacity. As the variety of the seed as received was found to be only 2 to 4 per cent a number of trials were made, using practically all the methods so far known of improving germination to see if it would be possible to increase the germination capacity by any of these methods. The results are summarized below in tabular form :—

	Treatments.	*Mean germination percentage.*
1	Seeds kept for germination without previous soaking	4
2	Seeds soaked in distilled water for 24 hours and then kept for germination	2
	A. Treatments with Hot water.	
3	Seeds immersed in boiling water for 1 minute	Nil.
4	Do. 2 minutes	Nii.
5	Do. 3 do.	Nil.
6	Do. 5 do.	Nil.
7	Do. 10 do.	Nil.
8	Do. 15 do.	Nil.
9	Do. 20 do.	Nil.
10	Do. 30 do.	Nil.
	B. Treatments with Growth Hormones.	
11	Seeds soaked for 24 hours in beta-indolyl acetic acid at 2 p.p.m.	4
12	Do. 5 p.p.m.	8
13	Do. 10 p.p.m.	2
14	Seeds soaked for 24 hours in alpha-naphthyl acetic acid 2 p.p.m.	8
15	Do. 5 p.p.m.	4
16	Do. 10 p.p.m.	4
17	Seeds soaked for 24 hours in beta-naphtoxy acetic acid 2 p.p.m.	Nil.
18	Do. 5 p.p.m.	2
19	Do. 10 p.p.m.	4
20	Seeds soaked for 24 hours in 2–4 dichlorphenoxy acetic acid 2 p.p.m.	2
21	Do. 5 p.p.m.	4
22	Do. 10 p.p.m.	2
	C. Sulphuric acid Treatments.	
23	Seeds treated with 2 per cent sulphuric acid	Nil.
24	Do. 5 do.	Nil.
25	Do. 10 do.	Nil.
	D. Abrasion Treatments.	
26	Rubbed on sand paper for 15 minutes	4
27	Seed and sand mixed and rubbed together for 30 minutes.. ..	6

In addition to these trials, the intrinsic viability of the embryos was chemically tested by means of 2–3–5 triphenyl tebrazolium chloride, which stains viable embryos red while non-viable embryos remain colourless. With this chemical it was found that only 14 per cent of the seeds had viable embryos. It was therefore concluded that it was not practicable to improve the germination capacity of this sample of indigo seed.

D. Bacteriology.

Sri M. Sanyasi Raju was in charge of the Bacteriology section. Three hundred and fifty-two research samples were analysed during the year. One hundred and forty-seven legume cultures were supplied to ryots and others.

1. *Soil Microbiology*—(*a*) *Black soils, Agricultural Research Station, Siruguppa.*—The eighth round of post-irrigation soil samples from the No manure, fallow, garden land and wet land blocks were examined for microbial population and activity on the same lines—as in previous years. The results are given in Appendix 40. The microbial count was rather very low in all the samples compared to the previous rounds. The garden land soil gave the highest value. The wet land soil was superior to the fallow and the "No manure" was the poorest. The work will be discontinued.

(*b*) *Black and red soils.*—Samples of black and red soils from the Cotton Breeding Station, and Central Farm, Coimbatore, were examined for the second year in succession and the results are given in Appendix 41. Due to droughty conditions the microbial population was considerably less than that of last year in both soil types. As in the previous year red soils gave higher count. The microbial activity, however, was greater in the black soil.

(*c*) *Microbial activity and population as influenced by manuring.*—The soils from the "No manure," "N+P+K" and "Cattle manure" plots of the O.P.M. were examined for the second year. Due to droughty conditions the total count was less than for the previous year in all samples. The "No manure" soil recorded the lowest population while the other two were about equal. Considerable increase in microbiological activity of the first two soils was noticed (vide Appendix 42).

2. *Associated growth of legumes and cereals.*—Field experiments on the associated growth of legumes and cereals were continued at the Pulses Sub-stations at Vizianagaram and Dharmapuri. The experiments were modified to include all the four principal pulses (blackgram, greengram, redgram and lab-lab) at both centres. In previous years only green gram and blackgram at Vizianagaram and redgram and lab-lab at Salem had been tried. In view of the effect of phosphates in promting the growth of legumes, superphosphate at 200 lb. per acre was also applied.

Due to prolonged drought, the crops failed completely at Dharmapuri and the experiment had to be given up. The droughty

condition adversely affected the growth of the crops at Vizianagaram also. The germination of lab-lab was poor but the other pulses came up well. The growth of cholam, however, was extraordinarily good. All the crops suffered in the early stages due to drought.

The results relating to these experiments are given in appendices 43 to 50. The yield of cholam was highest in the blackgram series, followed by greengram, lab-lab and lastly redgram. The best return was secured from the combination of half pulse and half cholam.

The plant materials and the soils taken at the pre-sowing stage and after the harvest of the crops were analysed for N and the N balanace worked out. Depletion of the soil nitrogen due to crop growth was noticed and this was more marked in the sub-soil than in the surface. Due to the droughty conditions nitrogen fixation by nodule bacteria was evidently not satisfactory. The depletion of soil nitrogen was greatest when cholam and pulses were grown together. As is to be expected pure pulses alone caused the least depletion.

3. *Selection of legume cultures.*—Fresh cultures of root nodule organisms specific to various legumes were isolated and their efficiency tested. One hundred and forty-seven cultures were supplied to the departmental officers and to ryots for field scale inoculation of legume seeds prior to sowing.

4. *Green manure and green leaf manure studies—microbiological aspects.*—The microbiological aspects of the work carried out on green manuring of paddy have already been reported under section B of the report dealing with manures.

E. Agro-Industries.

Studies on barley for malting purposes.—Cholam malt possesses very poor diastatic activity. Barley is the cereal used all over the world for malting purposes. With the object of using barley malt for securing better yields of cholam malt extract barley strains were obtained from the Economic Botanist, United Provinces, and also from the Punjab. The samples were examined for (1) diastatic activity ; (2) effect of storage on the diastatic activity ; (3) variation in diastatic power with temperature and (4) saccharifying power.

(1) *Diastatic activity of different strains—*

Variety.	*Diastatic power in °L at 30°C.*
N.P. 21	137·1
C. 50	180·0
C. 84	190·3
C. 251	200·0
C.N. 292	205·2

C. 251 and C.N. 292 are the most suitable for malting purposes. The Punjab variety type No. 4 was poor both in germination and dastatic power.

(2) *Diastatic power at different temperatures* —As C.N. 292 had been found to be the most suitable type work on the determination of the variation of diastatic power with temperature was confined to this sample only.

Temperature °C.	*D.P. expressed as °L.*
50	354·4
55	390·9
60	389·6
65	Nil.

The results indicate that the maximum diastatic power is attained between 55° and 60°C. The enzyme is completely destroyed at 65° C. so that 55 ° C. may be taken as safe temperature for the extraction.

(3) *Saccharifying power.*—This work again was confined to the best variety C.N. 292. Experiments with varying amounts of added starch (1 to 25 parts) showed that 1 part of barley malt is capable of acting on 20 parts of starch and converting the later into soluble forms of carbohydrates.

(4) *Effect of storage on malting quality.*—The diastatic power of the five barley types given under (1) was determined after storage for five months with the results given below :—

Variety.	*D.P. in °L at the start.*	*At 30°C. after storage for five months.*
N.P. 21	137·1	144·2
C. 50	180·0	184·1
C. 84	190·3	181·9
C. 251	200·0	174·6
C.N. 292	205·2	245·6

In the case of the first three samples there was no appreciable change. C. 251 has shown a decrease and C.N. 292 a considerable increase in Lintner value.

IV. Miscellaneous.

Publications.—The following papers were submitted for publication during the year :—

(1) Manuring of rice in relation to maintenance of soil fertility and increased production—P. D. Karunakar and T. Rajagopalan.

(2) The place of minor elements in growing food crops with special reference to rice—T. R. Narayanan.

(3) Polysaccharides of rice with special reference to quality —E. J. Verghese. Thesis submitted for M.Sc. degree of the University of Madras.

(4) A physiological approach to some coconut problems— T. R. Narayanan.

(5) Soil Survey for Fruit Development, Ceded Districts— G. K. Chidambaram, M. Sundaram and N. Raghunatha Rao.

(6) Studies on quality of chewing tobacco—Meenampalayam and Jafna varieties—P. D. Karunakar, M. Sanyasi Raju, P. Sathyanarayana and Miss Thangamani.

(7) Preliminary studies on pH fluctuations in rice soils during the growth of rice plants—P.D. Karunakar and F.L. Daniel.

(8) Fodder scarcity and the possibilities of exploiting straw processing in the Madras Presidency—A. Mariakulandai.

Exhibition and exhibits.—The section participated in the All-India Swadeshi and Industrial Exhibition held at Madras in December 1948 to January 1949. Exhibits were also sent in connection with exhibitions of the same kind at various other places. Exhibits representing the salient features of the work of the section were also supplied to the Industrial Museum at Madras.

Visitors.—The following were some of the distinguished visitors to the section during the year :—

(1) His Excellency the Governor of Madras.

(2) The Hon. the then Premier (Sri O. P. Ramaswami Reddiar).

(3) The Hon. the then Minister for Agriculture (Sri K. Madhava Menon).

(4) The Hon. the then Minister for Food (Sri T. S. S. Rajan).

(5) Srimathi Kuttiamalu Amma, M.L.A.

(6) Srimathi Ammu Swaminathan, M.C.A.

(7) Mr. F. W. A. Morris, I.C.S., Collector of Coimbatore.

(8) Sri G. D. Naidu.

Strength of staff as on 30th June 1949.—Particulars regarding the strength of the staff permanent and temporary as on 30th June 1949, are given in Appendix 51 as required in the Director of Agriculture's Circular No. X 3. 1222/48, dated 24th January 1949.

Acknowledgment.—I have great pleasure in placing on record the loyal co-operation of all my staff.

P. D. KARUNAKAR,
Government Agricultural Chemist.

APPENDIX I (*a*).

	Tenkasi red soil clay.	*Valliyur red soil clay.*	*Coimbatore red soil clay.*	*Hasanur black soil clay.*	*Hasanur brown soil clay.*
	(On moisture free basis.)				
Loss on ignition	13·0	12·51	..	17·03	14·48
Combined SiO_2	37·31	40·21	38·45	43·48	36·70
Free SiO_2+HCl insoluble minerals.	6·99	2·01	7·29	7·57	8·12
H.F. Residue	..	0·72	..	2·88	2·85
Al_2O_3	26·05	33·77	28·86	19·26	27·25
Fe_2O_3	14·35	10·86	11·80	9·51	12·10
CaO	1·09	0·35	0·69	1·51	0·43
MgO	..	..	..	1·45	..
K_2O	..	0·81	..	0·29	..
Na_2O	..	..	..	..	..
Molar ratio—SiO_2 (Combined Al_2O_3.	2·46	2·02	2·30	3·84	2·3
Combined SiO_2/R_2O_3 ..	1·82	1·68	1·80	3·73	1·8

APPENDIX I (*b*).

Analysis of 2 per cent NaOH extract of clay fractions from different soils.

	SiO_2	*Al_2O_3*	*Total.*	*SiO_2/Al_2O_3 Molar Ratio.*
Aziznagar (black)	1·56	0·55	2·11	4·82
Ariyalur (black)	1·25	0·67	1·92	3·18
Hasanur (black)	2·61	2·75	5·36	1·6
Hasanur (brown)	6·86	6·30	13·16	1·81
Tenkasi (red)	4·58	6·52	11·10	1·17
Nanguneri—Valliyur (lateritic red).	1·60	4·75	6·35	0·58

APPENDIX 2.

Results of analysis of soil samples from the horticultural experimental plot—Bearing Orchard, Maniangote, Wynaad—Results expressed as percentages on oven dry basis.

HIGHER GRADIENT.

Heads of analysis.	Tree No. 4.			Tree No. 74.			Tree No. 114.		
	0–1′	1–2′	2–3′	0–1′	1–2′	2–3′	0–1′	1–2′	2–3′
Loss on ignition	11·43	10·39	10·48	9·66	9·12	8·29	12·61	9·42	11·45
Insolubles	59·74	59·33	57·08	61·72	62·62	64·97	51·41	51·01	49·48
Solubles (by diff.)	28·83	30·28	32·44	28·62	28·26	26·74	35·98	39·57	39·07
R_2O_3	27·80	29·28	31·48	27·51	27·75	26·64	34·27	39·21	38·69
CaO	0·107	0·060	0·064	0·059	0·029	0·029	0·089	0·054	0·049
K_2O	0·170	0·136	0·206	0·177	0·159	0·151	0·128	0·213	0·063
P_2O_2 (total)	0·120	0·078	0·089	0·129	0·101	0·086	0·113	0·093	0·094
Nitrogen (total)	0·163	0·105	0·081	0·117	0·084	0·065	0·163	0·108	0·079
Carbon (oxidizable matter)	1·257	0·923	0·892	0·856	0·847	0·629	1·552	1·420	0·958
P_2O_5 (Available)	0·0011	Traces.	Traces.	0·0015	0·0008	0·0006	0·0013	0·0007	Traces.
K_2O	0·0098	0·0067	0·0067	0·0059	0·0032	0·0028	0·0057	0·0058	0·0054
pH	5·62	5·55	5·65	5·94	5·77	5·91	5·58	5·45	5·61
Clay	..	46·74	47·41	40·09	40·79	39·06	48·88	47·33	47·14
Silt	..	11·72	13·51	15·07	15·83	13·96	23·16	23·84	25·88
Fine sand	..	15·14	10·39	19·92	17·02	17·74	11·83	10·06	9·83
Coarse sand	..	25·28	27·73	24·43	26·43	28·14	15·95	15·57	13·86
Acid solubles	..	1·12	0·96	0·49	..	1·10	..	3·20	3·29
Total	—	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

LOWER GRADIENT.

	Tree No. 16.			*Tree No.* 63.			*Tree No.* 105.		
	0–1′	1–2′	2–3′	0–1′	1–2′	2–3′	0–1′	1–2′	2–3′
Loss on ignition	12·43	10·64	10·76	9·80	9·96	9·48	13·46	12·45	11·75
Insolubles	54·17	50·69	51·75	61·67	59·85	56·96	56·10	55·67	54·11
Solubles (by diff.)	33·40	38·67	37·49	28·53	30·19	33·56	30·44	31·88	34·14
R_2O_3	33·09	37·10	36·39	26·92	29·64	32·20	29·31	30·83	33·36
CaO	0·146	0·069	0·064	0·089	0·058	0·066	0·132	0·089	0·064
K_2O	0·180	0·156	0·146	0·178	0·221	0·207	0·144	0·193	0·139
P_2O_5 (total)	0·139	0·115	0·078	0·119	0·095	0·092	0·125	0·112	0·097
Nitrogen	0·185	0·103	0·062	0·150	0·101	0·068	0·220	0·146	0·098
Carbon (oxidizable matter)	1·590	1·005	0·735	1·101	0·967	0·716	2·320	1·120	1·268
P_2O_5 (Available)	0·0014	0·0001	0·0001	0·0015	0·0006	0·0006	0·0017	0·0009	0·0005
K_2O (Available)	0·0075	0·0071	0·0074	0·0062	0·0028	0·0034	0·0092	0·0074	0·0097
pH	5·68	5·79	5·89	5·67	5·80	5·67	5·52	5·76	5·42
Clay	47·88	51·19	50·16	41·59	49·01	52·16	49·83	49·99	53·48
Silt	19·03	18·69	20·44	13·22	13·71	14·86	14·13	17·17	17·14
Fine sand	9·82	10·89	12·63	17·08	15·21	14·47	11·94	10·69	10·29
Coarse sand	20·52	15·73	15·19	27·16	22·71	15·33	20·26	19·20	16·89
Acid solubles	2·75	3·50	1·58	0·95	..	3·18	3·84	2·95	2·20
Total ..	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

APPENDIX 3.

O.P.M.—Crop No. 79—Cumbu Co 2. Sown on 21st October 1948. Harvested on 22nd January 1949.

Plot number.	*Treatment.*	*Acre yield (lb.).* *Grain.*	*Straw.*	*Plot number.*	*Treatment.*	*Acre yield (lb.)* *Grain.*	*Straw.*
1	'No'	130	118	6	KP	241	168
2	N	225	165	7	K	189	110
3	NK	284	223	8	P	109	120
4	NP	398	350	9	CM	355	286
5	NPK	356	338	10	CMR	210	152

APPENDIX 4.

N.P.M.—Crop No. 39—Cumbu Co. 3. Sown—9th January 1949.
Plot area—5 cents. Harvests I—19th April 1949.
Nett area—3·95 cents. Harvests II—2nd May 1949.

Plot number.	*Treatment.*	*Acre yields (lb.).* *Grain.*	*Straw.*	*Plot number.*	*Treatment.*	*Acre yields (lb.).* *Grain.*	*Straw.*
EASTERN SERIES.				WESTERN SERIES.			
1	'No'	867	1,941	11	'No'	703	2,457
2	N	753	1,524	12	N	848	2,317
3	NK	778	1,668	13	NK	931	1,749
4	NP	892	1,564	14	NP	1,044	1,874
5	NPK	918	1,792	15	NPK	937	2,013
6	KP	776	1,429	16	KP	1,146	2,272
7	K	810	2,299	17	K	817	2,342
8	P	1,069	2,978	18	P	1,120	1,818
9	CM	1,202	3,362	19	CM	1,450	3,473
10	CMR	684	2,389	20	CMR	981	2,025

APPENDIX 5.

Results of comparative value of common green manure crops experiment—1948-49.

Green Manure.

Field—A Block—Wetland.
Layout—4 × 4 Randomized blocks.
Size of plots—4·45 cents.

Variants—Dhaincha, Pillipesara, Sunnhemp, Cowpea.
Sown—30th April 1948.
Harvested—21st and 22nd July 1948.

Summary of conclusions.

	Dhaincha.	*Pillipesara*	*Sunnhemp.*	*Cowpea.*	*G.M.*
Lb. per acre	18,651	18,651	21,642	20,501	19,842

'Z' test satisfied or not—No.

APPENDIX 6.

Paddy.

Field—A Block—Wetland.
Size of plot—5·02 cents.
Variety—G.E.B. 24.

Layout—5 × 4 Randomized blocks.
Variants—Dhaincha, Pillipesara, Sunnhemp, Cowpea.
Planted—12th to 15th August 1948.
Harvested—2nd December 1948.

Particulars.	*Dhaincha.*	*Pillipe-sara.*	*Sunnhemp.*	*Cowpea.*	*Control.*	*G.M.*
Grain.						
Lb. per acre	3,626	3,626	3,467	3,327	1,753	3,168
			S.E.	146	C.D.	176·57
Percentage on control	206·83	206·83	197·76	189·76	100	80·68
			S.E.	8·33	C.D.	10·071
'Z' test Yes or No, P = 0·05	Yes.	..	..	..	..	..
Straw.						
Lb. per acre	7,311	6,415	6,554	5,299	1,753	5,459
			S.E.	487·66	C.D.	299·37
Percentage on control	417	365·93	373·86	302·28	100	311·41
			S.E.	2·33	C.D.	17·08

'Z' test Yes or No,
P = 0·05—Yes.

Conclusions—Grain, Dhaincha, Pillipesara, Sunnhemp, Cowpea, Control.
Straw, Dhaincha, Sunnhemp, Pillipesara, Cowpea, Control.

APPENDIX 7.

Field—D Block—Wetland.
Size of plot—5·24 cents.
Layout—5 × 4 Randomized blocks.

Variants—Dhaincha, Pillipesara, Sunnhemp, Cowpea.
Sown—28th May 1948.
Harvested—11th to 15th August 1948.

Summary of conclusions.

Particulars.	*Dhaincha.*	*Pilli-pesara.*	*Sunnhemp.*	*Cowpea.*	*Control.*	*G.M.*	*S.E.*	*C.D.*
Lb. per acre	30,895	20,821	13,167	22,253	..	21,792	1,513·6	33·04
Percentage over general mean ..	141·78	95·54	60·42	102·09	..	100	6·96	15·17

'Z' test satisfied or not—Yes.

Couclusions—Dhaincha, Cowpea, Pillipesara, Sunnhemp.

APPENDIX 8.

Green Manure—Dry Matter.

Particulars.	*Dhaincha.*	*Pilli-pesara.*	*Sunnhemp.*	*Cowpea.*	*G.M.*	*'Z' test satisfied or not.*	*S.E.*	*C.D.*
Lb. per acre	7,863	2,748	3,836	3,206	4,409	..	1,207	2,630
Percentage over general mean ..	178·36	62·35	87·02	72·73	100	Yes.	30·11	59·65

Conclusions—Dhaincha, Sunnhemp, Cowpea, Pillipesara.

APPENDIX 9.

Paddy.

Field—D Block, Wetland
Layout—5 × 5 randomized blocks.

Variants—Dhaincha, Pillipesara, Sunnhemp, Cowpea.
Planted—5th to 7th September 1948.
Harvested—10th to 14th December 1948.
Size of plots—5·24 cents.
Variety—G.E.B. 24

Summary of conclusions.

Particulars.	*Dhaincha.*	*Pillipesara.*	*Sunnhemp.*	*Cowpea.*	*Control.*	*G.M.*	*'Z' test satisfied or not.*	*S.E.*	*C.D.*
Grain.									
Lb. per acre	3,703	3,492	3,455	3,264	2,729	3,320	..	199·00	346·74
Percentage over control	135·68	129·95	126·56	119·59	100	121·68	Yes.	7·28	12·71
Straw.									
Lb. per acre	4,657	4,752	3,759	4,409	2,780	4,065	..	421·5	612·4
Percentage over control.	167·11	170·59	134·93	158·23	100	145·88	Yes.	15·30	21·98

Conclusions—Grain : Dhaincha, Pillipesara, Sunnhemp, Cowpea, Control.

Straw : Pillipesara, Dhaincha, Cowpea, Sunnhemp, Control.

APPENDIX 10.

Succulency and decomposability of green manures.

Green manure.	A Block. *Leaf to stem ratio.*	A Block. *Original moisture.* PER CENT.	A Block. *Nitrogen, D.B.* PER CENT.	A Block. *Co2 per day per gm. D.N.* MGM.	D Block. *Original moisture.* PER CENT.	D Block. *Nitrogen D.B.* PER CENT	D Block. *Co2 per day per gm. D.N.* MGM.
Dhaincha	0·41 : 1	72·25	2·57	9·22	74·58	1·76	8·41
Sunnhemp	0·37 : 1	72·64	2·26	16·23	70·97	1·52	13·47
Pillipesara	0·83 : 1	84·32	2·56	29·21	85·59	2·46	32·29
Cowpea	0·80 : 1	78·64	2·31	30·40	86·83	1·88	32·09
(Control) soil	..	..	..	6·23	..	..	8·45

APPENDIX 11.

Nitrogen, acid hydrolysable sugars and Co_2 of green manures (1947–48 *sample*).

Green manure.	*Nitrogen.*	*Total acid hydrolysable sugars.*	*CO^2 evolved per day per gram. d.m.*
	PER CENT.	PER CENT.	MGM.
Dhaincha	2·36	17·93	9·22
Sunnhemp	2·26	13·05	12·49
Pillipesara	2·43	16·59	14·08
Cowpea	2·38	17·82	20·28

APPENDIX 12.

Comparative efficiency of common green manure crops—A Block (1948–49).

Green manure.	*Co_2 evolved mgm. daily per gm. d.m.*	*Yield of green matter.*		*Dry matter yield.*	*Nitrogen per acre.*	
		1947–48. LB. PER ACRE.	1948–49. LB. PER ACRE.		*Per cent N.*	*Total N.*
Dhaincha	6·34	8,810	18,665	5,175	2·57	132·7
Sunnhemp	23·19	4,385	21,605	5,912	2·26	133·8
Pillipesara	22·44	6,775	18,648	3,981	2·56	101·9
Cowpea	26·07	10,200	20,438	3,204	2·31	74·1
Soil Control	8·89	..	..	..	..	..

APPENDIX 13.

D. Block (1948–49).

Green manure.	*Co_2 mgm. daily per gm. d.m.*	*Yield of green matter lb./acre.*	*Amount of dry matter lb./acre.*	*Nitrogen.*	*Total nitrogen per acre.*
				PER CENT.	
Dhaincha	8·41	30,895	7,863	1·76	115·6
Sunnhemp	13·47	13,167	3,836	1·52	48·6
Pillipesara	32·29	20,821	2,748	2·46	56·6
Cowpea	32·09	22,253	3,206	1·88	50·5
Control—Soil ..	8·45	..	..	..	..

APPENDIX 14.

A. Block—Green manure experiments—Carbon dioxide evolution and Bacterial population.

Treatment.	Co_2 No dextrose mgm.	Co_2 1 per cent dextrose mgm.	Increase over control.	Per cent increase due to dextrose.	Bacto-population surface soil.		Per gm. Sub-soil after G.M. harvest.
					Before G.M. sowing.	After G.M. harvest.	
			PER CENT.	PER CENT.			
Control	8·89	23·12	..	160·11	1,440,000	1,800,000	710,000
Dhaincha	6·34	19·76	−28·68	211·84	2,700,000	4,520,000	1,240,000
Sunnhemp	23·19	34·17	160·8	47·36	3,590,000	2,530,000	1,430,000
Pillipesara	22·44	39·78	152·4	77·27	3,580,000	4,270,000	1,040,000
Cowpea	26·07	30·91	193·2	14·73	1,890,000	3,980,000	910,000

APPENDIX 15.

A. Block—Experiments ; Soil, Nitrogen, Moisture and loss on ignition.

Treatment.	Soil N 1947–48.	Before green manure sowing.			After green manure harvest.		
		Moisture.	Loss on ignition.	Nitrogen.	Moisture.	Loss on ignition.	Nitrogen.
		PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Dhaincha	0·117	7·24	6·18	0·131	7·20	6·15	0·099
Sunnhemp	0·106	6·41	5·86	0·097	5·89	4·90	0·076
Pillipesara	0·120	7·04	6·22	0·112	6·57	5·92	0·096
Cowpea	0·103	7·01	6·13	0·106	5·74	4·93	0·075
Control	0·079	6·41	6·28	0·081	5·73	4·07	0·053

APPENDIX 16.

D. Block—Green manure experiments—Carbon dioxide evolution and Bacterial population.

Treatment.	Co_2—No dextrose mgm.	Co_2—1 per cent mgm.	Increase due to dextrose.	Per cent increase over control.	Bacto-population after G.M. harvest.
			PER CENT.	PER CENT.	
Control	20·94	43·56	108·0	..	2,870,000
Dhaincha	24·93	23·32	— 6·44	19·10	3,950,000
Sunnhemp	8·28	22·44	171·0	— 60·47	2,970,000
Pillipesara	16·81	26·69	58·78	— 19·72	2,880,000
Cowpea	19·37	35·73	84·45	— 7·49	2,380,000

APPENDIX 17.

D. Block Experiments—Soil—Moisture, Nitrogen and loss on ignition.

Treatment.	N before green manuring sowing.	After G.M. harvest.		
		Moisture	Loss on ignition.	Nitrogen.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Dhaincha	0·117	6·89	6·53	0·096
Sunnhemp	0·112	6·07	5·86	0·097
Pillipesara	0·108	6·00	5·76	0·097
Cowpea	0·110	6·31	6·27	0·101
Control	0·118	6·77	6·02	0·099

APPENDIX 18.

Fertility index as revealed by Co_2. A. Block. After harvest of paddy.

Treatment.	Soil alone mgm. Co_2.	Soil + 1 per cent dextrose mgm. Co_2.	Increase due to 1 per cent dextrose.	Per cent increase over control.
Surface soil.			PER CENT.	
Control	* 23·25	25·30	8·78	..
Dhaincha	6·71	20·97	212·47	— 17·13
Sunnhemp	19·38	43·98	126·89	73·82
Pillipesara	21·93	41·26	87·86	62·86
Cowpea	32·19	46·27	43·75	91·56
Sub-soil.				
Control	* 29·04	33·75	16·21	..
Dhaincha	7·28	18·17	149·56	— 74·92
Sunnhemp	16·06	34·85	116·98	— 37·43
Pillipesara	15·88	28·71	90·59	— 45·32
Cowpea	18·63	36·92	98·11	— 35·84

* Will be repeated again.

APPENDIX 19.

D. Block—After harvest of paddy.

Treatment.	Soil alone mgm. Co_2.	Soil + 1 per cent dextrose mgm. Co_2.	Increase due to 1 per cent dextrose.	Per cent increase over control.
Surface soil.			PER CENT.	
Control	20·94	43·56	108·00	..
Dhaincha	24·93	23·32	— 6·44	19·10
Sunnhemp	* 8·28	22·44	171·00	— 60·47
Pillipesara	16·81	26·69	58·78	— 19·72
Cowpea	19·37	35·73	84·45	— 7·49
Sub-soil.				
Control	18·00	27·06	50·32	..
Dhaincha	26·49	42·72	61·27	47.17
Sunnhemp	* 11·44	19·10	66·95	— 36·44
Pillipesara	20·52	26·10	27·38	14.00
Cowpea	* 6·86	19·14	179·0	— 61·87

* Will be repeated again.

APPENDIX 20.

Green Manure Experiments with paddy—A. Block Wetlands (1948–49).

Green manure.	*Green weight lb. per acre.*	*Dry weight lb. per acre.*	*Total nitrogen.* LB.	*Co_2 evolved by a gram of dry matter in 24 hours mgm.*	*Paddy yield.* *Grain per acre.* LB.	*Straw per acre.* LB.	*Loss on ignition.* PER CENT.	*Soil surface nitrogen.* PER CENT.	*Sub-soil nitrogen.* PER CENT.	*Co_2 evolved by soil in 24 hours mgm.*	*Bacterial population of soil.*
Dhaincha	18,665	5,175	132·7	9·22	3,625	5,603	6·15	0·100	0·057	6·34	4,520,000
Sunnhemp	21,605	5,912	133·8	16·23	3,463	5,547	4·90	0·076	0·045	23·19	2,530,000
Pillipesara	18,648	3,981	101·9	29·23	3,622	5,534	5·92	0·096	0·043	22·44	4,270,000
Cowpea	20,438	3,204	74·1	30·40	3,315	4,587	4·93	0·075	0·030	26·07	3,980,000
Control	..	..	..	(Soil 8·89)	1,893	1,648	4·07	0·053	0·027	8·89	1,800,000

APPENDIX 21.

Green Manure Experiments with paddy—D. Block (1948–49).

Green manure.	*Green matter lb. per acre.*	*Dry matter lb. per acre.*	*Total nitrogen.* LB.	*Co_2 evolved per dry gram of matter mgm.*	*Paddy yield.* *Grain per acre.* LB.	*Straw per acre.* LB.	*Loss on ignition.* PER CENT.	*Surface soil nitrogen.* PER CENT.	*Sub-soil nitrogen.* PER CENT.	*Co_2 evolved by soil in 24 hours.*	*Bacterial population of soil.*
Dhaincha	30,895	7,863	115·6	8·41	3,703	4,657	6·53	0·117	0·039	24·93	3,950,000
Pillipesara	20,821	2,748	56·6	32·29	3,492	4,752	5·76	0·108	0·051	16·81	2,880,000
Sunnhemp	13,167	3,836	48·6	13·47	3,455	3,759	5·86	0·172	0·047	18·28	2,970,000
Cowpea	22,253	3,206	50·5	32·09	3,264	4,409	6·25	0·110	0·047	19·37	2,380,000
Control	..	..	..	(Soil 8·45)	2,729	2,780	6·02	0·118	0·047	20·94	2,870,000

APPENDIX 22.

Green Manuring of paddy—Nitrogen balance—Pot Culture Experiments with O.P.M. soil.—Preliminary Study, 1947–48.

Treatments.	I *No manure (Control).*	II *Green manure at 5,000 lb. per acre.*	III *Ammonium sulphate single dose N = That in treatment II.*	IV *Ammonium sulphate double dose N = Double than in treatment II or III.*
	GMS.	GMS.	GMS.	GMS.
Nitrogen originally supplied.				
1 Soil	3·0860	3·0860	3·0860	3·0860
2 Manure	..	0·1691	0·1691	0·3382
3 Seedlings	0·0110	0·0110	0·0110	0·0110
4 Total supplied	3·0970	3·2661	3·2661	3·4352
Nitrogen recovered.				
5 I. Residual soil	2·9800	3·3125	3·4875	3·4950
II. Plant material.				
6 Grain	0·0436	0·0824	0·1108	0·1675
7 Straw	0·0344	0·0567	0·0429	0·0833
8 Roots	0·0110	0·0107	0·0065	0·0099
9 III. Drainage water	0·0121	0·0137	0·0138	0·0217
10 Total recovered	3·0811	3·4760	3·6615	3·7774
11 Net gain or loss (column 10 — column 4)	— 0·0159	+ 0·2099	+ 0·3954	+ 0·3422

NOTE.—(1) Each treatment was replicated four times. The results reported are average values.
(2) The nitrogen of the drainage water reported is the total nitrogen for the entire volume of drainage water collected for all the rounds of analysis.

APPENDIX 23.

Green manure decomposition in paddy soils—Analysis of drainage water from 12,000 grams of soil.

Number.	*Treatments.*	*Round of analysis.*	pH.	*Oxygen consumed* 3 *mins.* MGM.	*Oxygen consumed* 30 *mins.* MGM.	*Ammonia Nitrogen.* MGM.	*Total Nitrogen.* MGM.
I	No manure blank (uncropped)	1	6·6	1·75	33·75	1·94	29·90
		2	7·3	3·75	17·50	0·96	26·88
		3	7·1	4·13	12·65	0·75	16·17
		4	6·9	3·30	13·75	0·78	13·86
		5	6·85	1·10	39·60	1·97	6·92
II	No manure control (cropped)	1	7·1	1·62	34·25	1·89	26·92
		2	7·5	5·50	19·88	0·57	11·62
		3	7·3	4·26	12·79	0·68	12·51
		4	7·2	1·10	7·15	0·74	9·86
		5	7·0	1·28	29·52	1·14	5·47
III	Green manure blank (uncropped)	1	7·5	2·50	39·50	2·61	7·70
		2	7·4	6·00	10·38	2·41	21·98
		3	7·8	6·05	14·85	1·09	17·34
		4	7·4	1·93	16·78	1·30	27·10
		5	7·2	1·10	33·92	1·69	11·86
IV	Green manure at 5,000 lb. acre (cropped).	1	7·5	1·65	38·30	1·99	6·75
		2	7·3	6·25	18·88	1·47	18·39
		3	7·9	5·89	20·90	1·28	16·71
		4	7·5	2·88	11·28	1·43	15·63
		5	7·2	1·38	33·18	0·63	15·99
V	Ammonium sulphate blank (uncropped)	1	6·6	2·00	22·50	1·03	40·60
		2	7·3	5·50	20·75	0·95	15·38
		3	7·1	4·68	17·05	0·69	15·40
		4	7·0	1·65	16·50	1·09	5·70
		5	7·1	1·65	8·52	1·02	10·78

VI	Amonium sulphate at equal N level as green manure (Treatment IV).	1	7·2	1·63	21·12	1·22	33·95
		2	7·3	4·00	14·25	1·02	16·94
		3	7·3	6·46	24·48	0·61	20·02
		4	7·2	1·24	12·38	0·85	3·18
		5	7·1	1·24	14·12	1·06	10·16
VII	Green manure at 10,000 lb. per acre	1	7·0	7·62	26·00	1·90	14·92
		2	7·3	19·75	29·00	1·19	28·73
		3	7·3	5·64	17·60	0·90	28·57
		4	7·1	2·20	6·19	0·88	14·32
		5	7·2	1·24	6·21	1·01	17·40
VIII	Ammonium sulphate at equal N level as green manure 10,000 lb. per acre.	1	7·4	5·13	19·25	1·71	26·75
		2	7·3	8·38	26·75	0·94	19·88
		3	7·3	5·09	14·99	1·06	17·68
		4	7·3	1·65	8·94	1·01	8·78
		5	7·1	1·10	9·16	1·26	16·01
IX	Green manure at 5,000 lb. plus ammonium sulphate at equal nitrogen dose, i.e., comb. of IV and VI.	1	7·5	4·63	24·40	1·70	22·75
		2	7·6	5·88	23·25	0·59	18·83
		3	7·4	4·26	11·92	0·62	17·33
		4	7.4	1·40	7.24	1·08	8·24
		5	7·1	1·24	13·16	1·14	27·21

No nitric and nitrous nitrogen could be detected.

APPENDIX 24.

Yield of paddy grain and straw in pot culture experiments—Average per pot.

	No manure.		*Green manure single dose.*		*Ammonium sulphate single dose.*		*Green manure double dose.*		*Ammonium sulphate double dose.*		*Green manure S.D. + Ammonium Sulphate S.D.*	
	Grain.	*Straw.*	*Grain.*	*Straw.*	*Grain.*	*Straw.*	*Grain.*	*Straw.*	*Grain.*	*Straw.*	*Grain.*	*Straw.*
	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.	GRAM.
					'D' Block soil.							
Average per pot in gram	2·96	10·16	6·13	10·83	6·58	12·88	7·14	10·59	10·37	14·90	8·80	12·88
Per cent increase over control ..	..	..	107·11	6·60	122·29	26·77	141·22	4·23	250·32	46·76	197·29	26·77
					K + P plot. O.P.M. field.							
Average per pot in gram	6·50	9·60	4·24	12·04	7·77	12·32	11·10	15·35	10·65	15·43	10·89	17·76
Per cent increase over control ..	..	..	—34·77	20·27	19·54	28·33	70·78	59·89	63·84	60·73	67·54	85·04

APPENDIX 25.

Green manure decomposition—Pot culture experiments with 'D' Block Soil.

Treatments—

1 No manure.
2 Green manure (Pillipesara) 5,000 lb. per acre.
3 Ammonium sulphate to supply same amount of N as (2).
4 Green manure (Pillipesara) 10,000 per acre.
5 Ammonium sulphate to supply same amount of N as (4).
6 Ammonium sulphate (3) plus green manure (2).

Conclusions—

	(5)	(6)	(3)	(4)	(2)	(1)	*C.D.*
Grain (yields)	370	266·7	266·7	233·3	200	100	23·7
Straw (yields)	150	130	130	110	110	100	11·19

With K plus P plot soil—O.P.M.

Conclusions—

	(4)	(6)	(5)	(3)	(2)	(1)	*C.D.*
Grain yield	170·8	167·5	163·9	119·5	65·2	100·0	36·6
	6	5	4	3	2		
Straw yield	185·0	160·7	159·9	128·3	125·4	100·0	1·33

APPENDIX 26.

Green manure decomposition studies—Field experiments—D. Block.

Field—D—Block Wet lands.
Size of the plot—Gross net.
Variety—G.E.B. 24.

Lay out 5×6 randomized blocks
Variants—6 as mentioned in Appendix 25.
Planted on
Harvested on

Particulars.	1	2	3	4	5	6	*G.M.*	*'Z' test satisfied or not P. = 0·05 per cent.*	*S.E.*	*C.D.*
Grain—										
Lb. per acre	1,989	2,199	2,270	2,301	2,541	2,322	2,270	..	4·899	41·09
Per cent increase over control.	..	10·5	14·1	15·7	27·8	16·7	..	No.	..	..
Straw—										
Lb. per acre	2,128	2,376	2,552	2,632	3,261	2,842	..	..	3,286	13·71
Per cent increase over control.	..	11·6	19·9	23·7	53·2	33·5	..	Yes.	..	..

Conclusions: Straw (yields) 5 6 4 2 3 1

APPENDIX 27.

Some commonly used green leaf manures.

Green leaf manure.	*Ratio stem leaf.*	*Moisture in green state.*		*Nitrogen per cent dry basis.*		*Decomposability milligrams Co_2 daily.*		*Nitrifiability per cent.*	
		Stem.	*Leaf.*	*Stem.*	*Leaf.*	*Stem.*	*Leaf.*	*Leaf.*	*Time in weeks.*
1 Glyricidia	1 : 1·89	76·95	76·00	1·84	3·98	17·27	20·13	26·67	6
2 Calatropis	1 : 0·80	81·87	85·04	1·40	3·52	18·37	18·90	23·17	4
3 Croton sparsiflorus	1 : 1·20	47·18	64·22	2·10	3·85	12·91	10·28	23·53	4
4 Cassia siamia	1 : 3·80	42·79	55·58	1·54	2·42	..	..	10·80	4
5 Thespesia (Poovarasu)	1 : 2·3	51·53	62·92	1·56	3·28	29·96	42·35	21·33	6
6 Delonix	1 : 3·9	55·85	66·28	1·47	2·27	..	..	—3·09	6
7 Pongamia (Pungam)	1 : 1·34	54·50	58·70	1·89	3·71	12·76	13·09	6·13	6
8 Pillipesara	1 : 1·2	79·27	86·94	1·63	4·01	19·69	25·05	20·23	4

APPENDIX 28.

Carbon and nitrogen distribution in the green manure Experimental plots, Siruguppa—1947–48.

[Results expressed in percentage on dry basis (100°C.)—Samples taken one month after tne addition of manure.]

First round—Irrigated plots.

Heads of analysis.	*No manure fallow Plot No. 1.*			*No manure cropped Plot No. 2.*			*Green manure fallow Plot No. 3.*			*Green manure cropped Plot No. 4.*		
	1′.	2′.	3′.	1′.	2′.	3′.	1′.	2′.	3′.	1′.	2′.	3′.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Carbon (oxidizable matter)	0·760	0·710	0·678	0·792	0·800	0·761	0·801	0·803	0·810	0·958	0·889	0·800
Nitrogen (total)	0·027	0·026	0·023	0·028	0·030	0·026	0·035	0·032	0·034	0·034	0·030	0·030
Carbon nitrogen	28	27	29	28·3	26·6	29·2	23·0	25·0	24·0	28·8	29·6	26·7
Average of three layers	..	28·0	..	..	28·0	..	..	24·0	..	..	28·4	..

Second round—Samples taken two months after the addition of manure.

Carbon (oxidizable matter)	0·784	0·726	0·717	0·790	0·810	0·811	1·06	0·852	0·716	0·896	0·863	0·822
Nitrogen (total)	0·027	0·030	0·027	0·028	0·028	0·030	0·040	0·030	0·027	0·032	0·030	0·031
Carbon nitrogen	29·0	24·2	24·7	28·2	28·9	27·0	26·5	28·4	26·5	27·0	28·7	26·5
Average of three layers	..	25·9	..	..	28·0	..	..	27·1	..	..	27·4	..

Third round—Samples taken after the harvest of the crop (T_1 cholam).

Carbon (oxidizable matter)	0·788	0·701	0·767	0·824	0·800	0·810	0·896	0·820	0·711	0·890	0·860	0·822
Nitrogen (total)	0·028	0·024	0·028	0·028	0·029	0·030	0·040	0·028	0·026	0·040	0·028	0·030
Carbon nitrogen	28·0	29·2	27·4	29·4	27·6	27·0	22·4	29·2	27·3	22·2	30·7	27·4
Average of three layers	..	28·2	..	..	28·0	..	..	26·3	..	..	26·8	..

First round—Dry plots.

Heads of analysis.	*No manure fallow Plot No. 5.*			*No manure cropped Plot No. 6.*			*Green manure fallow Plot No. 7.*			*Green manure cropped Plot No. 8.*		
	1′.	2′.	3′.	1′.	2′.	3′.	1′.	2′.	3′.	1′.	2′.	3′
	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
Carbon (oxidizable matter)	0·734	0·714	0·661	0·700	0·674	0·710	0·840	0·830	0·850	1·03	0·805	0·804
Nitrogen (total)	0·028	0·025	0·022	0·027	0·026	0·026	0·035	0·029	0·028	0·041	0·032	0·030
Carbon nitrogen	26·2	28·6	30·0	26·0	26·0	27·3	24·0	28·6	30·4	25·1	24·5	26·8
Average of three layers	..	28·3	..	..	26·4	..	..	27·7	..	..	25·5	..
Second round—Samples taken two months after the addition of manures.												
Carbon (oxidizable matter)	0·808	0·772	0·800	0·843	0·804	0·800	1·000	0·819	0·812	0·896	0·858	0·809
Nitrogen (total)	0·029	0·029	0·030	0·029	0·029	0·026	0·036	0·029	0·027	0·035	0·028	0·030
Carbon nitrogen	27·8	26·6	26·6	29·0	27·7	30·0	28·0	28·0	29·0	25·6	30·7	26·9
Average of three layers	..	26·6	..	..	28·9	..	..	28·3	..	..	27·7	..
Third round—Samples taken after the harvest of the crop (T 1 cholam).												
Carbon (oxidizable matter)	0·724	0·701	0·700	0·816	0·820	0·814	0·999	0·727	0·735	0·969	0·956	0·821
Nitrogen (total)	0·028	0·029	0·028	0·030	0·029	0·030	0·034	0·029	0·029	0·042	0·036	0·030
Carbon nitrogen	25·8	24·1	25·0	27·0	28·2	27·1	29·4	25·0	25·3	23·0	26·5	27·3
Average of three layers	..	25·000	..	..	27·4	..	..	26·6	..	..	25·6	.

NOTE.—Dose of green manure 10,000 lb. per acre.

APPENDIX 29.

Fertility studies in Central Farm Wet lands—Summary of Results, 1946–1949.

	B block.	*L block.*	*C block.*	*F block.*
Fertility rating	(Low).	(Medium) low.	(Medium) high.	(High).
Average of 25 years (1920–1945) (in pounds per acre)—				
Grain	2,543	2,859	3,616	3,942
Straw	3,220	3,329	4,125	5,117
Total outturn	5,763	6,188	7,741	9,059
Soil analysis (1946) top 0–6″ soil layer—				
Nitrogen	0·083	0·115	0·140	0·162
Available P_2O_5	0·013	0·018	0·022	0·028
Available K_2O	0·024	0·020	0·034	0·019
Soil analysis top 6–12″ soil layer—				
Nitrogen	0·071	0·081	0·107	0·126
Available P_2O_5	0·017	0·016	0·019	0·022
Available K_2O	0·030	0·015	0·024	0·016
Soil analysis top 12–18″ soil layer—				
Nitrogen	0·037	0·040	0·065	0·093
Available P_2O_5	0·012	0·011	0·016	0·024
Available K_2O	0·043	0·024	0·027	0·017
1946 Season—Paddy Strain Co. 3 yield per acre—				
Grain	2,153	1,854	3,169	2,825
Straw	3,599	4,355	5,281	9,696
Total	5,752	6,209	8,450	12,521
Plant characters in 100 day old plants—				
Height (cms.)	130·0	129·5	143·5	127·3
Tillers	5·6	6·3	7·8	7·6
Fresh weight of shoot material per plant (gms.).	38·5	47·4	59·8	58·9
1947 Season—Co. 3 yield—				
Grain	2,767	3,179	4,541	1,582
Straw	5,501	7,071	6,413	3,142
Total	8,268	10,250	10,954	4,724
Plant characters—				
Height (cms.)	77·9	88·8	61·9	63·1
Tillers	..	..	..	..
Fresh weight of shoots (gms.)	52·8	69·8	25·6	22·5
1948 Season—Co. 3 yield—				
Grain	1,431	1,735	2,863	2,062
Straw	5,967	5,780	4,013	4,662
Total	7,398	7,515	6,876	6,724
Plant characters—				
(*a*) 45 days old—Fresh weight	..	..	..	..
(*b*) 100 days old—Height (cm.)	71·8	103·5	136·6	116·7
Tillering	7·3	5·8	10·9	6·8
Fresh weight (gms.)	81·5	61·5	125·5	53·8
Nitrogen content in shoot material—	PER CENT.	PER CENT.	PER CENT.	PER CENT.
(*a*) 45 days old	1·44	1·66	1·47	1·07
(*b*) 100 days old	0·73	0·83	0·77	0·71

APPENDIX 30.

Relation between Nitrogen and Paddy yields.

	B block.	*L block.*	*C block.*	*F block.*
(Rating)	(Low fertility).	(Medium low).	(Medium high).	(High fertility).
Nitrogen per cent in soil—				
0–6″ layer	0·082	0·115	0·140	0·168
6–12″ layer	0·071	0·081	0·107	0·148
12–18″ layer	0·037	0·040	0·065	0·104
Average yield in lb. per acre of grain+straw for 1920–1925 period.	5,763	6,188	7,741	9,059
Total yield for 1946 season	5,752	6,209	8,450	12,521
Do. 1947 season	8,268	10,250	10,954	4,724
Average yield in lb. per acre of grain + straw for 1948 season.	7,398	7,515	6,876	6,724
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Nitrogen content in paddy plants (in 1948)—				
(*a*) Seedling stage (45 days old)	1·44	1·66	1·47	1·07
(*b*) Milk stage (95–100 days old)	0·73	0·83	0·77	0·71

APPENDIX 31.

Effect of Trace Element Sprays on Paddy Yields (1948 *and* 1947 *seasons*).

Number and treatments.	1948 season. (*Mean values from six replications*).				1947 season. (*Mean values from four replications*).			
	Grain.		*Straw.*		*Grain.*		*Straw.*	
	Lb./ acre.	*Per cent.*	*Lb./ acre.*	*Per cent.*	*Lb./ acre.*	*Per cent.*	*Lb./ acre.*	*Per cent.*
1 Control—Not sprayed ..	1,363	100·0	5,161	100·0	3,319	100	5,469	100
2 $CuSO_4$ at 20 lb. in 100 gallons per acre.	1,558	114·3	5,393	104·5	3,730	112·3	5,988	109·5
		$CuSO_4$ 10 lb.						
3 $ZnSO_4$ at 10 lb. in 100 gallons per acre.	1,753	128·6	5,936	115·0	3,687	111·1	6,242	114·1
		$ZnSO_4$ 5 lb.						
4 $MnSO_4$ at 10 lb. in 100 gallons per acre.	1,688	123·8	5,768	111·8	3,950	119·0	5,877	107·5
		$MnSO_4$ 5 lb.						
5 Cu + Mn at the above doses.	1,438	104·8	5,265	102·0	3,192	96·1	5,346	97·7
		Cu + Mn.						
6 Cu + Mn + Zn at the above doses.	1,645	120·6	5,780	112·0	4,104	123·6	5,619	102·7
		Cu + Mn + Zn.						
Differences significant or not.	Yes.		No.		No.		No.	
Five per cent level critical difference.		18·9 per cent.		16·0 per cent.		50·3 per cent.		37·1 per cent.

Conclusion.—1948 season: Zn, Mn, Cu+Mn+Zn, Cu, Cu+Mn, Control.

APPENDIX 32.

Effect of Presoaking Paddy seed in Phosphate solutions.

Pot culture Experiment in 10″ × 10″ glazed pots, with 13 treatments, replicated 4 times each in two soils, NPK and NK from the Permanent Manurial Plots.

Variety—Co. 13 (110 days).
Sown on—28th February 1949.
Flowered in May 1949.
Harvested—8th June 1949.

(*a*) Summary of results from both soil types, NPK and NK—

Number.	Treatments.	Grain yield. Mean per pot (Gms.)	Grain yield. Per cent on control.	Straw yield. Mean per pot (Gms.)	Straw yield. Per cent on control.	Plant height (Cms.)	Tillering.	Flowering (days).
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)	(*i*)
1	Soaked and dried in 1/3 weight of seed of distilled water—Once.	21·35	94·5	37·39	70·2	98·1	2·9	76·3
2	Soaked and dried, in 1/3 weight of seed of distilled water—Thrice.	17·50	77·5	33·00	63·6	94·6	2·8	79·3
3	Soaked and dried in K_2HPO_4—10 per cent.	21·35	94·5	45·50	84·7	99·2	3·4	76·8
4	Soaked and dried in KH_2PO_4—20 per cent.	20·88	92·4	58·44	112·7	101·1	3·5	77·4
5	Soaked and dried in K_2HPO_4—10 per cent.	22·10	97·8	51·25	98·8	104·5	3·2	80·3
6	Soaked and dried in K_2HPO_4—20 per cent.	25·06	110·9	48·63	93·8	103·0	2·8	77·1
7	Soaked and dried in K_3PO_4—10 per cent.	*27·86	121·1	57·26	110·4	106·0	3·3	77·4
8	Soaked and dried in K_3PO_4—20 per cent.	†31·35	138·8	52·58	101·4	†109·5	3·0	75·8
9	Beta indole acetic acid—10 p.p.m.	*26·86	118·9	45·78	88·3	102·1	3·0	74·3
10	Do. 20 p.p.m.	*26·50	117·3	51·12	98·6	104·3	3·4	74·5
11	Control—Dry seed	22·59	100·0	51·86	100·0	98·8	3·6	76·9
12	Soaked and sown	21·00	93·0	52·74	101·7	101·3	3·0	76·4
13	Continuous light for 14 days in Conjunction with K_3PO_4.	19·34	85·6	51·89	100·1	94·9	†4·6	77·9
	Whether significant or not	Yes.		Yes.		Yes.	Yes.	No.
	Critical difference 1 per cent level ..	5·27	23·3	11·67	22·5	8·1	0·6	..
	Do. 5 per cent level ..	3·20	14·2	..	..	..	..	..

(*b*) Effect of soil—

Complete soil (NPK)	25·78 gms.	54·02 gms.	100·3 cms.	3·6	76·5
P—Deficient soil—NK	20·87 ,,	43·98 ,,	102·3 ,,	2·6	77·4
Whether significant or not	Yes.	Yes.	Yes.	Yes.	No.
Critical difference at 1 per cent level.	2·07 gms.	4·58 gms.	3·2 cms.	0·2	..

NOTE.—* Superior to control at 5 per cent level.

† Superior to control at 1 per cent level.

Conclusions.—(1) Grain: Ranking at 1 per cent level of significance.

8, 7, 9, 10, 6, 11, 4, 5, 1, 3, 12, 13, 2

Pre-soaking in 20 per cent K_3PO_4 solution has increased grain yield by nearly 40 per cent.

(2) Straw yield: Ranking at 1 per cent level of significance.

4, 7, 12, 8, 13, 11, 5, 10, 6, 9, 3, 1, 2

None of the phosphate pre-treatments is significantly better or worse than the control in straw yields.

(3) Plant Height: Ranking at 1 per cent level of significance.

8, 7, 5, 10, 6, 9, 12, 4, 3, 11, 1, 13, 2

Plants from seed soaked in K_3PO_4 solution are the tallest. The difference is significant at the 1 per cent level in the case of treatment 8 (soaking in 20 per cent K_3PO_4 solution).

(4) Tillering: Ranking at 1 per cent level of significance.

13, 11, 4, 10, 3, 7, 5, 12, 8, 1, 9, 2, 6

Pre-soaking in phosphate solutions has had no effect in improving tillering, except when combined with continuous illumination for 14 days.

(5) *Flowering.*—The deficiencies in the mean duration of flowering between the various treatments were not significant. The treatments have thus no effect in modifying the flowering earlines of the variety under study.

APPENDIX 33.

Vernalization in rice.

Summary of results of 1948 experiments expressed as percentages on controls = 100.

Strain number and treatments.	*Flowering.*	*Plant height.*	*Tillering.*	*Grain.*	*Straw.*
Adt. 3—					
DK—14 days	101·4	106·2	141·2	117·4	97·5
DK—7 days	98·9	99·4	126·7	94·1	97·7
L—7 days	96·9	92·9	110·8	75·2	98·7
L—14 days	98·6	104·5	99·9	135·8	95·4
PTB. 9—					
DK—14 days	..	..	..	84·7	87·7
DK—7 days	101·2	106·5	136·3	113·3	124·3
L—7 days	96·7	96·1	50·9	77·3	80·2
L—14 days	94·5	95·1	56·3	119·7	126·5
Co. 21—					
DK—14 days	97·8	87·3	105·9	107·1	109·9
DK—7 days	101·3	94·2	109·5	90·7	99·8
L—7 days	96·5	93·9	66·7	122·7	111·4
L—14 days	99·1	97·1	81·6	106·2	97·5
GEB. 24—					
DK—14 days	98·5	105·9	133·9	142·7	109·3
DK—7 days	96·9	102·4	139·5	135·4	130·3
L—7 days	97·7	106·6	154·9	182·2	134·7
L—14 days	99·1	103·2	152·5	163·9	131·8
AKP. 5—					
DK—14 days	98·7	104·6	77·1	99·7	75·8
DK—7 days	102·1	142·9	98·4	100·7	86·0
L—7 days	100·3	105·7	95·7	108·1	88·2
L—14 days	95·8	95·3	89·7	102·1	83·8
AKP. 8—					
DK—14 days	96·7	99·3	139·5	150·2	147·7
DK—7 days	98·4	100·6	102·6	140·1	133·2
L—7 days	99·4	103·2	106·2	127·0	123·0
L—14 days	99·9	100·8	141·3	125·4	121·6
MTU. 7—					
DK—14 days	94·7	108·4	106·3	122·9	97·9
DK—7 days	98·3	102·3	89·5	119·4	97·8
L—7 days	95·5	110·4	62·6	98·0	88·6
L—14 days	96·9	109·4	87·4	100·8	98·4
Co. 10—					
L—7 days	94·3	111·7	112·9	192·4	130·9
L—14 days	98·6	98·8	88·2	87·5	90·3
L—22 days	99·2	104·9	103·5	171·2	145·1
Co. 23—					
L—7 days	99·4	101·2	102·9	145·9	108·1
L—14 days	102·6	90·3	84·9	58·7	60·7
L—22 days	98·6	90·9	77·3	89·2	68·1
T. 672—					
L—7 days	97·4	108·9	102·0	250·7	117·0
L—14 days	85·2	99·6	145·6	108·1	115·2
L—22 days	100·1	85·9	96·6	54·8	71·8

Conclusions: (1) In practically every strain, it is possible to obtain a distinct increase in grain yield by some particular vernalization treatment, but certain varieties as for example GEB. 24 and AKP 8, are very responsive to nearly all forms of vernalization treatments.

(2) The straw yield increases are in general of a lower order than those in grain yield.

APPENDIX 34.

Effect of vernalization on rice—Summary of three years' results— 1946–1949—*Expressed as percentages on controls* = 100.

Treatment.	*Flowering.*	*Height.*	*Tillers.*	*Grain.*	*Straw.*	*Total outturn.*
ADT. 3—95–100 days—						
DK 14 days	97·8	106·2	141·2	109·8	104·7	103·1
DK 7 days	107·1	109·4	113·3	94·0	97·7	108·2
DK + Light (7 + 7)	98·7	102·5	106·4	110·9	130·6	103·2
Light 7 days	92·0	108·7	94·5	75·2	98·7	95·9
Light 14 days	93·0	103·8	97·2	154·1	92·2	107·0
CO. 21—100 days—						
DK 14 days	97·8	87·3	105·9	102·5	98·3	100·7
DK 7 days	96·3	93·7	101·6	90·7	99·9	96·9
DK + Light	101·3	104·8	105·4	93·9	95·0	121·5
Light—7 days	96·5	93·9	66·7	122·7	111·4	114·3
Light—14 days	99·9	90·6	81·6	103·8	96·4	98·8

Treatment.	*Flowering.*	*Height.*	*Tillers.*	*Grain.*	*Straw.*	*Total outturn.*
PTB. 10—100 days—						
DK—14 days	94·4	129·0	81·2	87·7	99·4	92·9
DK—7 days	100·6	90·8	100·0	113·3	124·3	101·7
DK + Light	94·5	109·7	94·8	93·1	88·7	106·0
Light—7 days	96·3	85·6	57·3	85·5	72·5	77·6
Light—14 days	95·9	92·9	56·3	96·8	113·3	103·1
GEB. 24—150 days—						
DK—14 days	95·7	109·0	113·4	142·8	109·8	109·7
DK—7 days	95·3	102·4	139·5	125·0	116·9	118·4
DK + Light	96·1	..	..	121·6	119·4	120·1
Light—7 days	95·9	111·4	115·8	151·4	117·3	142·9
Light—14 days	93·5	95·6	140·7	138·5	120·7	124·3
AKP. 5—200 days—						
DK—14 days	98·7	104·6	77·1	99·7	75·8	80·3
DK—7 days	102·1	142·9	98·4	100·7	86·0	88·3
DK + Light	..	..	..	..	..	..
Light—7 days	99·4	101·8	119·3	119·3	110·9	112·2
Light—14 days	93·9	97·7	136·8	124·5	120·4	135·9
AKP. 8—200 days—						
DK—14 days	88·8	90·8	112·5	150·2	147·7	125·4
DK—7 days	98·4	100·6	102·6	140·2	133·2	134·7
DK + Light	93·0	83·9	123·5	..	..	111·9
Light—7 days	99·4	103·2	106·2	127·0	123·0	124·0
Light—14 days	99·9	100·8	141·3	125·4	121·6	122·5
SLO. 18—210 days—						
DK—14 days	..	..	..	..	..	..
DK—7 days	..	..	..	..	..	..
DK + Light	..	..	..	..	..	..
Light—7 days	..	..	..	..	..	..
Light—14 days	97·5	96·7	137·5	105·9	111·6	110·5
MTU. 7—220 days—						
DK—14 days	101·2	102·1	98·6	122·9	97·9	96·9
DK—7 days	97·9	102·3	89·5	105·5	86·7	92·6
DK + Light	97·7	112·1	129·7	111·2	105·6	106·0
Light—7 days	96·6	102·9	183·2	98·0	88·6	89·9
Light—14 days	98·3	103·9	117·9	98·4	103·1	96·5

APPENDIX 35.

Nutrient deficiencies in ragi (effect on growth and yields).

Sown—2nd April 1948.
Harvested—9th August 1948.

Variety—Co. 1 (E.C. 593).
Treatments—9 × replications 4 in 10" × 10" glazed pots with 19 kilos of sand.

Treatments.	*Plant Height—Adult Plants.*	*Mean tillering.*	*Number.*	*Earheads weight.*	*Straw.*
1 Complete Nutrient solution (control).	100	100	100	100	100
2 Minus Nitrogen	76·1	24·6	27·6	22·1	18·8
3 —— Potassium	67·1	28·3	28·6	9·9	21·2
4 —— Phosphorus	65·6	33·4	33·7	11·2	21·1
5 —— Sulphur	106·0	72·6	50·2	84·6	91·5
6 —— Calcium	99·3	66·1	54·1	60·7	69·5
7 —— Iron	92·7	61·0	43·1	62·6	55·2
8 —— Magnesium	94·5	85·0	43·1	58·3	69·1
9 Tap water alone	67·2	30·9	28·6	17·2	20·2
Critical difference at 1 per cent level.	18·4	27·4	21·0	56·9	18·3

Plant Height : 5, 1, 6, 8, 7, 2, 9, 3, 4.

Sulphur deficient plants were taller than all other treatments.

Tillering :—1, 8, 5, 6, 7, 4, 9, 3, 2.

Tillering is not reduced by iron deficiency, but all other elements show a significant reduction in tillering, including sulphur deficiency which gave taller plants.

Earhead weight and number : 1, 6, 5, 7, 8, 4, 3, 9, 2.

Complete solution is greater than all other treatments.

Weight : 1, 5, 7, 6, 8, 2, 9, 4, 3.

(1) Deficiencies of S, Ca, Fe and Mg, did not reduce the earhead yield to significant levels, but—N, —K, and —P depressed it very markedly.

(2) The last 4 ranks are the same in both earhead weight and number.

APPENDIX 36.

Borax experiment on sweet potatoes.

Borax applied on 30th October 1948.
Vines planted on 30th November 1948.
Harvested on 29th May 1949.
Treatments—

(1) Control—No borax.
(2) Borax applied at 40 lb. per acre.
(3) Do. 80 lb. per acre.
(4) Do. 120 lb. per acre.

Field—F. No. 52-B.
Variety—Local broad leaved. White tubered type.
Layout—Randomized plots of 4 treatments replicated six times.
Plots size—60 × 25 square links = 1·5 cents.

Yield of tubers in pounds per plot.

Treatments.	Replications. (1)	(2)	(3)	(4)	(5)	(6)	Total	mean.	Per cent on control.	Acre yield in lb.
1 Control	136	111	32	66	56	32	433	72·2	100·0	4,811
2 40 lb. Borax	184	123	66	52	38	68	531	88·5	122·6	5,900
3 80 lb. Borax	147	95	24	54	58	26	404	67·3	93·3	4,489
4 120 lb. Borax	161	55	34	14	16	48	328	54·7	75·7	3,644
	628	384	156	186	168	174	1,696 lb.	C.D. at 5 per cent level.	52·6 per cent.	..

APPENDIX 37.

Effect of Boron on Lucerne yields.

Date of cutting.	*Control.*	*10 lb. Borax per acre.*	*20 lb. Borax per acre.*	*40 lb. Borax per acre.*
1 16th January 1948	1,168	1,144	1,232	1,216
2 16th February 1948	1,980	1,980	1,984	1,976
3 13th March 1948	2,616	2,672	2,736	2,744
4 7th April 1948	2,016	2,032	2,144	2,000
5 4th May 1948	1,664	1,552	1,648	1,696
6 31st May 1948	2,224	2,432	2,288	2,320
7 26th June 1948	1,632	1,760	1,440	1,776
8 21st July 1948	1,792	1,968	1,616	1,764
9 16th August 1948	1,536	1,840	1,664	1,788
10 11th September 1948	1,600	1,792	1,736	1,776
11 6th October 1948	1,258	1,296	1,264	1,456
12 22nd November 1948	1,136	1,456	1,248	1,408
Total of 12 cuttings	20,622	21,924	21,000	21,920
(per acre) ..	66,197	70,376	67,410	70,363
Percentage on control	100·0	106·3	101·8	106·3
Difference significant or not			Not significant.	

APPENDIX 38.

Effect of Presoaking groundnut in phosphate solutions—Experiment I.

Variety—A.H. 35.
Treatments—6.
Replications—4 in glazed pots 10" × 10" holding 19 kilos of sand.

P—deficient nutrient solution added at one litre per pot twice a week.
Sown—28th February 1949.
Harvested—4th July 1949.

Number.	Treatments.	Yield of pods. Fresh height mean pod per pot. GMS.	Yield of pods. Per cent on control.	Yield of pods. Dry weight. GMS.	Per cent on control.	Mean pod number per pot of 10 plants.	Total weight of plant material. GMS.	Mean plant height per cent.
1	Soaked in one-third weight of seed of distilled water *once* and dried.	60·00	114·3	23·50	110·6	40·5	213·2	27·4
2	Soaked in one-third weight of seed of distilled water twice.	51·75	98·6	21·00	98·83	35·0	213·8	27·5
3	Soaked in $CaHPO_4$—10 per cent.	53·50	101·9	18·50	87·08	34·0	214·6	26·9
4	Soaked in $CaHPO_4$—20 per cent.	66·62	127·3	27·38	128·9	43·5	263·3	30·5
5	Dry (Control)	52·50	100·0	21·25	100·0	31·8	228·3	28·3
6	Soaked 24 hours and sown wet ..	49·38	93·9	22·10	104·0	27·8	211·9	28·98
Whether significant or not		Not significant.		Not significant.		Significant at 5 per cent only.	Not significant.	Significant at 5 per cent level.
Critical difference at 5 per cent level.						19·7	62·0	2·25 c.m.

APPENDIX 39.

Effect of presoaking groundnut in phosphate solutions, Experiment II.

Sown—12th March 1949. Harvested—7th July 1949.

Number.	Treatments.	Yield of pods. Fresh weight pod mean per pot.	Yield of pods. Per cent on control 100.	Yield of pods. Dry weight.	Per cent on control 100.	Mean pod number per pot of 10 plants.	Per cent on control 100.	Total weight of plant material. GMS.	Total weight of plant material. Per cent on control.	Plant height. CMS.	Plant height. Per cent on control.
1	Soaked in one-third weight of seed of KH_2PO_4 solution at 2 per cent and dried.	82·9	195·0	39·00	183·5	44·0	174·6	332·1	135·9	31·2	119·2
2	Soaked in one-third weight of seed of KH_2PO_4 solution at 5 per cent and dried.	86·1	202·6	44·60	209·9	42·5	168·7	315·2	130·0	35·5	135·9
3	Soaked in one-third weight of seed of KH_2PO_4 solution at 2 per cent and dried.	32·5	76·4	9·25	43·53	22·5	89·3	207·7	85·7	21·6	82 8
4	Soaked in one-third weight of seed of K_3PO_4 solution at 2 per cent and dried.	39·6	93 2	17·88	84·16	25·2	100	226·0	93·2	25·0	95·9
5	Dry seed (Control)	42·5	100·0	21·25	100·0	25·2	100	242·5	100·0	26·1	100·0
6	Soaked 24 hours in water and sown wet.	40·8	96·0	19·58	92·15	23·8	94·4	219·5	90·5	25·4	97·2
Whether significant or not ..		Very highly significant.		Very highly significant.		Very highly significant.		Very highly significant.		Very highly significant.	
Critical difference at 5 per cent level.		18·99 gm.	44·6 per cent	11·21 gm.	52·79 per cent	9·15	36·2	54·1 gm.	22·2	3·7 cm.	14·4
Critical difference at 1 per cent level.		30·2	71·1	15·52	73·02	12·65	50·1	74·8	30·8	5·2	19·8

APPENDIX 40.

Microbial activity of black soils—Siruguppa.

Treatment.	Total Bacterial population 1946–47 per gramme.	Total Bacterial population. 1947–48 per gramme.	CO_2 evolved daily. 1946–47. Soil only. MGM.	1946–47. Soil + 1 per cent glucose. MGM.	1947–48. Soil only. MGM.	1947–48. Soil + 1 per cent glucose. MGM.
Block III No manure ..	1,320,000	270,000	2·89	10·72 271·16 per cent.	4·29	11·01 156·38 per cent.
Block V Wet land	1,905,000	670,000	12·83	18·50 44·20 per cent.	13·15	16·76 27·45 per cent.
Block VII Cultivated fallow.	2,701,000	370,000	16·09	21·56 29·18 per cent.	15·89	24·43 53·86 per cent.
Block VIII Garden land ..	4,444,000	1,100,000	21·73	21·60 —0·23 per cent.	20·20	19·23 —4·85 per cent.

APPENDIX 41.

Microbiological studies of black and red soils (1948–49).

Heads of analysis.	Nature and source of soil. Black soil. 11 E. (C.B.S.)	Black soil. 36A. C.F.	Red soil. 10 B. (C.B.S.)	Red soil. 28 C.F.
Total Bacterial population per gramme of soil.	150,000	130,000	400,000	590,000
Daily evolution of CO_2—soil alone	25·32	17·71	6·07	12·17
Daily evolution of CO_2—1 per cent glucose ..	40·15	31·60	14·23	35·77
Percentage difference in increase	58·56	78·65	100·48	151·36

APPENDIX 42.

Differently manured soils—O.P.M. Fileds (1948–49).

Nature of soil.	Total Microbial population.	CO_2—soil only. MGM.	CO_2 soil + 1 per cent glucose. MGM.	Difference in CO_2 due to 1 per cent glucose. MGM.	Per cent increase in CO_2. MGM.
No manure	420,000	7·92	16·15	8·23	103·91
Mineral manure N+P+K ..	650,000	15·33	27·19	11·86	77·37
Cattle manure	640,000	15·14	15·93	0·79	5·20

APPENDIX 43.

YIELD OF CHOLAM AND PULSE AT VIZIANAGARAM SUB-STATION, 1948–49.

Greengram series—Pounds per acre.

Treatment.	Cholam. Grain.	Cholam. Straw.	Pulse. Grain.	Pulse. Haulms or Bhusa.
Pure pulse or cholam	1,125	21,500	62·50	3,667
¾ pulse plus ¼ cholam	1,268	25,000	31·25	1,250
½ pulse plus ½ cholam	1,625	30,830	31·25	1,250
¼ pulse plus ¾ cholam	1,625	30,830	10·42	983·3

APPENDIX 44.

Blackgram series—Pounds per acre.

Treatment.	Cholam.		Pulse.	
	Grain.	Straw.	Grain.	Haulms or Bhusa.
Pure pulse or cholam	2,593	37,050	148·5	4,749
¾ pulse plus ¼ cholam	1,743	30,500	156·3	4,749
½ pulse plus ½ cholam	2,228	37,050	114·6	3,355
¼ pulse plus ¾ cholam	2,074	35,500	72·9	2,624

APPENDIX 45.

Redgram series—Pounds per acre.

Treatment.	Cholam.		Pulse.	
	Grain.	Straw.	Grain.	Straw.
Pure pulse or cholam	1,125	26,667	276·1	5,833
¾ pulse plus ¼ cholam	552	22,833	141·8	3,709
½ pulse plus ½ cholam	1,323	27,667	218·8	3,250
¼ pulse plus ¾ cholam	1,156	22,500	83·3	1,833

APPENDIX 46.

Lab-Lab series—Pounds per acre.

Treatment.	Cholam.		Pulse.	
	Grain.	Straw.	Grain.	Straw.
Pure pulse or cholam	1,375	19,500	} No pulse could be harvested as the crop failed to set pods.	
¾ pulse plus ¼ cholam	1,438	25,990		
½ pulse plus ½ cholam	1,438	23,000		
¼ pulse plus ¾ cholam	1,198	18,490		

APPENDIX 47.

ASSOCIATED GROWTH EXPERIMENTS—VIZIANAGARAM (1948–49).

Blackgram series.

Description.	Soil nitrogen—Pounds per acre.									
	Pure pulse.		¾ pulse + ¼ cholam.		½ pulse + ½ cholam.		¼ pulse + ¾ cholam.		Pure cholam.	
	Top soil.	Sub-soil.	Top soil.	Sub-soil.	Top soil.	Sub-soil.	Top soil.	Sub-soil.	Top soil.	Sub-soil.
Before crop	1,374	1,125	1,259	1,136	1,354	1,080	1,312	1,172	1,122	1,286
After crop	1,240	952	1,276	857	1,066	1,035	1,110	949	1,203	1,195
Balance ..	−134	−173	+17	−279	−288	−45	−202	−223	+81	−91

APPENDIX 48.

Nitrogen in pounds in crops per acre.

Material.	Pure pulse.	¾ pulse + ¼ cholam.	½ pulse + ½ cholam.	¼ pulse + ¾ cholam.	Pure cholam.
Cholam, straw	..	86·32	126·70	134·20	63·36
Cholam, grain	..	28·13	35·20	33·89	42·30
Pulse—grain	5·80	6·50	5·23	3·01	..
Pulse—Bhusa	50·34	53·67	40·25	28·61	..
Total N ..	56·14	174·62	207·38	199·71	105·66

APPENDIX 49.

Greengram series—Soil Nitrogen pounds per acre.

Description.	Pure pulse.		¾ pulse + ¼ cholam.		½ pulse + ½ cholam.		¼ pulse + ¾ cholam.		Pure cholam.	
	Top soil.	Sub-soil.	Top soil.	Sub-soil	Top soil.	Sub-soil.	Top soil.	Sub-soil.	Top soil.	Sub-soil.
Before crop ..	1,343	1,148	1,418	1,286	1,348	1,273	1,340	1,198	1,348	1,292
After crop ..	1,234	1,039	1,303	1,069	1,203	1,094	1,262	1,033	1,247	1,114
Balance ..	—109	—109	—115	—217	—145	—179	—78	—165	—101	—178

APPENDIX 50.

Nitrogen in pounds in crops per acre.

Material.	Pure pulse.	¾ pulse + ¼ cholam.	½ pulse + ½ cholam.	¼ pulse + ¾ cholam.	Pure cholam.
Cholam, straw	..	66·7	76·2	82·6	66·2
Cholam, grain	..	20·7	25·6	25·0	17·7
Pulse—grain	2·9	1·3	1·3	0·4	..
Pulse—Bhusa	45·5	13·4	14·6	11·3	..
Total N ..	48·4	102·1	117·7	119·3	83·9

APPENDIX 51.

Staff.

Name of service and post.	Number of sanctioned posts.	
	Permanent.	Temporary.
I. Madras Agricultural Service—		
Government Agricultural Chemist	1	..
Assistant Agricultural Chemists	3	..
Agricultural Bacteriologist	1	..
Soil Physicist (post vacant)	1	..
Plant Physiologist	..	1
Gazetted Assistant in Chemistry	..	1
Total ..	6	2

Name of service and post.	Number of sanctioned posts.	
	Permanent.	Temporary.
II. Madras Agricultural Subordinate Service—		
Upper Subordinates—Main Section	18	..
Do. At Anakapalle	1	..
Do. Tungabhadra Project ..	1	..
Do. Teaching Section	..	1
Do. Plant Physiology Scheme.	..	1
Do. Compost Scheme	..	2
Do. Scheme for improving yield of potatoes in Nanjanad.	..	2
Do. Cholam Effect Scheme ..	..	1
Total ..	20	7
Fieldmen—Cholam Effect Scheme	..	1
Do. Improving Yield of Potatoes in A.R.S. Nanjanad	..	1
Total ..	..	2
III. Madras General Subordinate Service—		
Laboratory Attenders—Main Section	7	..
Do. At Anakapalle	1	..
Do. Plant Physiology Scheme.	..	1
Do. Teaching Section ..	..	2
Do. Compost Scheme ..	..	1
Total ..	8	4
IV. Madras Ministerial Service—		
Upper Division Clerk—Compost Scheme ..	..	1
Lower Division Clerks—Main Section	3	..
Total ..	3	1
V. Madras Inferior Service—		
Peons—Main Section	7	..
Do. Plant Physiology Scheme	..	2
Do. Compost Scheme	..	1
Total ..	7	3

COIMBATORE,
26th July 1949.

P. D. KARUNAKAR,
Government Agricultural Chemist.

ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR THE FASLI YEAR 1358 (1948–49).

DETAILED REPORT.

The report of the work of the section for the year 1948–49 is presented under the following heads :—

I. Diseases of food crops.

II. Diseases of commercial crops.

III. Diseases of fruits.

IV. Diseases of vegetables.

V. Agro industries.

VI. Grow More Food Scheme.

VII. Miscellaneous investigations.

VIII. Teaching.

IX. Propaganda.

X. Plant quarantine, legislation and advisory work.

I. Diseases of Food Crops.

1. *Rice diseases*—(*a*) *Blast—Piricularia oryzae*—(i) *Varietal resistance trials.*—One hundred and sixty-five cultures of rice were utilized in these tests which were conducted on the same lines as in previous years in three series. In the first series 99 cultures made up of 49 long duration, 35 medium duration and 15 short duration types were included. The second series consisted of the progeny of the crosses of Co. 4 with Coimbatore strains numbering 59 in all. Seven cultures of the progeny of crosses between Kamban samba and Molaguluku varieties were grown in the third series. Adt. 10 was grown as the control. The incidence of blast was very low even in the susceptible control in spite of spray inoculation with spore suspension. Consequently the evaluation of the relative resistance of the cultures was not possible.

(ii) *Monthly sowing trials.*—In order to correlate the relation if any between the time of sowing and the incidence of blast five cultures representing types exhibiting different degrees of resistance were grown in replicated plots every month from August to December. Observations of the incidence of the disease in different plots were recorded. But definite conclusions could not be drawn owing to the sparse occurrence of blast.

(iii) *Seedling resistance of exotic varieties.*—Two hundred cultures from the collection of the world varieties available with the Paddy Specialist were grown in the nursery plots to find out if any of the exotic cultures exhibited high resistance. The seedlings were repeatedly sprayed with spore suspension to induce

infection. No definite results could be obtained owing to the failure of infection due to the weather condition not being conducive to the incidence of blast.

(iv) *Incidence of blast in wet and dry nurseries.*—It has been observed in other countries that rice plants grown under conditions of reduced water-supply are more affected by blast than those receiving plentiful supply. To find out whether this holds good under local conditions Adt. 10 was grown at the Agricultural Research Station, Aduthurai and at Coimbatore under semi-dry conditions and under normal irrigation. The incidence of blast was very negligible at Coimbatore. But at Aduthurai it was observed that the incidence of blast was more on plants growing under semi-dry conditions.

(v) *Effect of graded doses of nitrogen on the incidence of blast.*—Nitrogenous manures either as ammonium sulphate or as groundnut cake were applied at three different levels to supply 40 pounds, 80 pounds and 120 pounds of nitrogen per acre. Four cultures of rice were used three being resistant cultures, viz., Co. 4, Co. 25 and Co. 26 and the fourth one susceptible, viz., Adt. 10. The manures were applied two months after transplanting. The incidence of blast was negligible in all the plots. The yield figures show that there is an increase in yield directly proportional to the amount of nitrogen applied. The results are given below :—

TABLE I.—*Effect of different levels of nitrogen on yield of rice.*
(Yield of grain in oz.).

Culture.	*Control.*	*Ammonium sulphate.*			*Groundnut cake.*		
		40 *lb.* *N.*	80 lb. *N.*	120 *lb.* *N.*	40 *lb.* *N.*	80 *lb.* *N.*	120 *lb.*
Co. 4	151·0	181·5	210·0	222·3	175·0	217·3	223·8
Co. 25 (3912) ..	121·3	161·5	218·3	284·5	180·0	319·5	268·8
Co. 26 (3840) ..	136·5	187·5	211·8	219·8	189·3	240·8	281·0
Adt. 10	113·0	160·8	198·8	259·8	164·8	234·3	302·8

The effect of the application of varying levels of nitrogen phosphoric acid and potash individually and in combination on the incidence of blast and yield of grain was investigated. Adt. 10 was the variety grown in miniature plots and the manures were applied one month after planting. There was no incidence of blast during the season in any of the plots. The yield figures showed that under the conditions of the experiment there was significant response to the application of nitrogen and not of phosphoric acid or potash.

Study of the pathogen.—Two isolates of the parasite one from Wynaad and the other from Coimbatore were inoculated on four varieties of rice. Differences were noticed in the intensity of infection on different varieties. The Wynaad isolate exhibited higher virulence.

Studies on the germination of the spores of the parasite showed that the spores germinate only when sown on drops of water and when the surrounding atmosphere has a relative humidity of 100 per cent. *Dinebra retroflexa*, *Digitaria marginata*, *Leersia hexandra* and *Panicum repens* were found to serve as collateral hosts.

(*b*) *Foot-rot of rice—Fusarium moniliforme—Varietal resistance trials.*—Twenty-two cultures of rice which exhibited high resistance to blast under field conditions were used to note their reaction towards foot-rot as compared with Co. 10 and Co. 11. The seeds were artificially infected with the fungus and sown in randomized plots. Records of incidence of foot-rot were made. It was observed that several of these cultures were resistant to foot-rot. The results are shown below :—

TABLE II.—*Incidence of foot-rot in the different cultures.*

Culture.	*Percentage of infection.*	*Culture.*	*Percentage of infection.*	*Culture.*	*Percentage of infection.*
Co. 10	98·7	2,555 (B.C.P. 2)	15·8	2,380	8·9
Co. 11 ..	63·6	2,713	14·3	3,342	8·8
Ptb. 16 ..	29·3	2,552	14·0	2,744	8·5
3839	20·4	3,381	12·4	2,554	8·1
8036	19·9	2,488	11·1	2,559	7·4
3635	18·7	3,273	10·9	2,364	4·7
3912	16·7	2,366	9·4	Ptb. 7	1·1
3840	15·9	3,185	8·9	GEB. 24	0·0

Fungicidal trials.—The trials for the evaluation of the efficacy of various fungicides on the control of foot rot were continued. Ten new fungicides were included in the experiments. These were Agrosan 4, Aagrano, Peronox, Dithane Z78, Folosan, Fermate, Yellow cuprocide, Merfusan, Nomersan and Fusarex. The experiments were carried out on the same lines as in previous years. The fungicides were used at the rate of one gram per pound of seed except in Aagrano which was used in two strengths, viz., one gram and 0·5 gram per pound of seed. Ceresan, Agrosan GN, Agrosan 4, Aagrano at both the strengths, Nomersan and Atiran were all equally effective in controlling infection. The results are recorded below :—

TABLE III.—*Percentage of incidence of foot-rot under various treatments.*

Fungicide.	*Percentage of foot-rot.*	*Fungicide.*	*Percentage of foot-rot.*
Fusarex	68·4	Atiran	0·3
Folosan	66·8	Ceresan	0·0
Merfusan	24·5	Aagrano (0·5 gram) ..	0·0
Yellow cuprocide ..	19·5	Aagrano (1 gram) ..	0·0
Peronox	15·4	Agrosan 4	0·0
Dithane	15·3	Agrosan GN	0·0
Nomersan	1·9	Control	84·7

Study of the pathogen.—Four isolates of *Fusarium moniliforme* obtained from Coimbatore, Erode, Gobichettipalayam and Maruteru respectively were used for infecting six varieties of rice to note their relative virulence. Periodical mortality counts were taken. The results showed that the isolate from Erode was the most virulent, GEB. 24 and PTB. 7 were highly resistant to all the isolates.

(*c*) *Stem rot of rice—Sclerotium oryzae.*—Reports of incidence of this disease were received from several parts of Tanjore Ottadam variety (udu) was most affected. In many of the areas this disease was observed to come in the wake of jassid infestation. Direct treatment with fungicides is of no avail in this case. In some villages demonstration of the method of controlling the disease by draining away the water and allowing the soil to dry for a short period before letting in fresh water, was conducted with good results. Where this treatment was not practicable the affected areas were marked out for later destruction of the straw and stubbles by fire in order to eradicate the fungus.

2. *Ragi—(Eleusine coracana)—Blast—Piricularia sp.—Varietal resistance.*—These trials were repeated using 16 fresh cultures of ragi kindly supplied by the Millet Specialist. They were sown at the Millets Breeding Station and periodically sprayed with spore suspension to induce infection. All the cultures were found to be equally susceptible. To test the susceptibility of allied species of *Eleusine* and plants of *E. coracana* with different chromosome numbers inoculation experiments were conducted on seedlings and older plants. *Eleusine indica, E. verticillata* and *E. coracana* with different chromosome numbers were found to be susceptible.

3. *Cereal rusts—Wheat rusts—Puccinia graminis* (*black rust*) *P. glumarum* (*Yellow rust*) and *P. triticina* (*brown rust*).—At the instance of the Government of India a ban was imposed on the cultivation of wheat throughout the Province during the period from April 1st to September 30th for three years commencing from 1948 with the object of controlling the epiphytotics of rusts on wheat in peninsular India. This was due to the impression that the summer wheat grown on the hills of Nilgiris and Pulneys supplied the inoculum for the incidence of rusts in North India. The notification was made late and consequently ryots had already sown wheat. On their representation the enforcement of the ban was modified by the Government and time was allowed for harvesting the crop already sown. During 1949 the ban has been notified in time and the crop has not been sown in the province.

Periodical inspections of the crop on the Nilgiris were made by this section and by the staff of the Plant Protection Directorate, New Delhi. It is interesting to note that "black rust" for the control of which the ban is mainly directed was singularly absent on the hills in the summer crop. Further inspection made during December 1948 of the wheat crop in different parts of the province

showed that black rust was prevalent in a severe form in Coimbatore and Bellary but not on the Nilgiris. This raises the question whether the view that the Nilgiris form a source of infection is correct.

Further surveys made in March 1949 showed that black rust had appeared on the Nilgiris much later than on the plains. The local samba wheat was quite free from this rust and Bola wheat and other varieties of *Triticum vulgare* cultivated in small areas were infected.

Brown rust was present all over the area on all varieties of wheat. Yellow rust was noticed to a limited extent only. Seeds of the differential hosts of wheat were obtained from the Wheat Specialist, Central Provinces, and sown at the Agricultural Research Station, Wellington, in small plots. Some of the varieties did not come up well. Those that developed exhibited natural infection by black rust. From these results of observations of the natural infection it is surmised that the race of black rust present in the area was No. 21. This has to be confirmed by inoculation experiments. The records of infection are as shown below :—

TABLE IV.—*Statement showing relative incidence of black rust on the differential hosts.*

Variety.	Intensity of infection.	Variety.	Intensity of infection.	Variety.	Intensity of infection.	Variety.	Intensity of infection.
Acme	Heavy	Arnautka	Heavy	Kubanka	Heavy	Reliance	Nil.
		Little Club	Heavy	Marquis	Heavy	Spelmar	Medium
						Vernal	Nil.
						Agra local	Heavy
Finkorn	Nil.	Kota	Heavy	Mindum	Heavy	Samba wheat	Nil.

Seeds of five varieties of wheat reported to be highly resistant to rust have been imported from Australia and will be sown at the Nilgiris after the ban period.

Sorghum rust—Puccinia purpurea.—The study of this rust was continued. Seeds of the ten strains Co. 1 to Co. 10 were obtained from the Millet Specialist and seedlings were raised. These were inoculated with the same collection of rust in the pot culture house. All the ten strains were readily infected in eight to twelve days. Co. 5 was found to be the most susceptible under the conditions of the experiment. The same kind of rust was observed in the field on five other species of sorghum besides *Sorghum vulgare*. These were *Sorghum sudanense*, *S. halepense*, *S. nitens*, *S. verticelliflorum* and *S. arundinaceum*. Cross inoculation experiments proved that the rust easily passed on from one host to another and to *Sorghum vulgare* and vice versa. Thus there was no evidence of specialization of parasitism in this rust at Coimbatore.

Periodic examination of all the species and cultures of sorghum grown on the Millets Breeding Station was made. The incidence

of rust exhibited variation in different cultures. The cultures belonging to the species *S. conspicuum*, *S. caffrorum*, *S. nigricans* and *S. caudatum* were much less affected by rust. The observations will be continued in the coming season.

The Cytogeneticist placed at my disposal a number of plants of *Sorghum halepense* having different chromosome numbers for testing their susceptibility to rust. These were inoculated with rust and the plants having 56 and 61 chromosomes did not exhibit any infection. The others were readily infected.

The teliospores of this rust were formed in December-January and were found to germinate soon after collection in 1 per cent sugar solution. Infection experiments were carried out with the germinating spores on several species of *Ipomaea*, *Solanum* and *Ocinuum* without success.

Cumbu—(Pennisetum typhoides) rust—Puccinia penniseti.—The complete life cycle of this rust was worked out for the first time. The teliospores germinated in three days in three to four per cent sugar solutions. Germinating spores were inoculated on several dicotyledonous plants. Successful infection was obtained on leaves and petioles of *Solanum melongena* in nine days. Pycnia and aecia developed on hypertrophied spots. The aeciospores readily infected cumbu plants. Thus it was established that the brinjal plant is the alternate host for this rust.

Digitaria marginata, *Paspalum scrobiculatum*, *Cenchrus ciliaris* and *Cenchrus setigerus* were not infected by this rust. A hybrid of *P. typhoides* x *P. purpureum* was readily infected.

Examination of all the cultures of cumbu at the Millets Breedings Station revealed that a few cultures of African types had much less infection. These have been marked out for further observation.

Tenai (Setaria italica) rust—Uromyces setariae—italicae.—Cross inoculation experiments were conducted with the rust of tenai on *Setaria glauca* and *Setaria verticillata*. There was no infection. The strain of the rust on *Setaria glauca* did not infect *Setaria italica*. Thus specialization of parasitism is evident in this rust. Miniature plots of the cultures Co. 1, 4054, 3560, 3396, 2528 were grown and the natural infection of rust observed. The plants of 3560, 3396 and 2528 were destroyed before seed setting on account of infection. Co. 1 and 4054 had 50 per cent or more of crop and plant infection.

4. *Sorghum long smut—Tolpoporium Ehrenbergii.*—Large scale infection of sorghum by this smut was prevalent in Madura and Ramnad districts in April and May. Since the mode of infection is not established experiments on floral infection were conducted on a standing crop of sorghum in flower. Dusting the spores on the opening flowers, spraying a spore suspension with force on the young inflorescence and injection of the spore suspension into the flower with the hypodermic syringe were tried. But in no case infection was noticed. Further trials were in progress.

II. Diseases of Commercial Crops.

1. *Cotton—Blackarm—Xanthomonas malvacearum.*—Cultures of *Gossypium hirsutum*, *G. purpurascens* and *P. barbadense* are subject to heavy infection by this disease in this Province. Experiments have been in progress for over three years in collaboration with the Cotton Specialist for selection of disease resistant cultures. Forty-five cultures were grown during this season with Co. 2 and Co. 3 as control. The plants were periodically sprayed with bacterial suspension in order to facilitate infection and spread of the disease on the experimental plants. The plants were later individually examined for angular leaf spot and blackarm symptoms and graded into different categories according to the intensity of infection. At the end of the season it was found that two cultures 79–2 and 458-1 were significantly superior to the controls in having the least incidence of disease. These have been selected for further trials during the coming season. The culture Co. 4, B 40-21 which was believed to be resistant was found to be readily infected under artificial inoculation.

2. *Sugarcane mosaic—Varietal resistance trials.*—The trials with the new batches of canes evolved at the Sugarcane Breeding Station, Coimbatore, to evaluate their resistance to mosaic disease were continued. Ten cultures were planted and the incidence of infection recorded periodically. Further trials have been suspended as a new Sugarcane section has been opened at Anakapalle with an Assistant Mycologist on the staff. Furthermore a senior assistant in mycology has been appointed at the Sugarcane Breeding Station, Coimbatore. These studies will be undertaken by them in future.

3. *Cardamom research.*—This is the fifth year of the scheme in progress at Singampatti, Tirunelveli district. A further extension of the scheme has been sanctioned by the Indian Council of Agricultural Research till 1952.

Some more cardamom areas which had not been surveyed so far were visited. Two more types were added to the collections. At Valparari the types which had been raised from rhizome were in various stages of growth. Seven types have been planted for comparative trials in field plots. Two others are not yet fit for planting in the field. None of them have flowered. Many of the types and varieties raised from seeds at Singampatti have been planted in the varietal trial plots. The progeny of the contact crosses have reached the second nursery stage. Further crosses have been made during the year. Eight of the best selections previously made have been advanced to yield trials. The botanical studies of the types are being continued.

The problem of successful raising of seedlings was tackled. Provision of a good roofing over the seed beds is preferable to natural shade. After sowing, the bed has to be covered with dry grass to prevent damage by drip. Addition of Bordeaux mixture

or copper sulphate solution to the soil has deleterious effect on the germination. Experiments have been laid out to note, the effect of age of seed and scarification of seed before sowing on germination. Application of superphosphate or ammonium phosphate to the soil round the clumps has reduced the incidence of clump rot.

The life-history of cardamom thrips (*Taeniothrips cardamomi*) is being followed. It was found that monthly application of gammexane or nicotine sulphate checked the infestation of thrips effectively.

4. *Tobacco—Damping off—Pythium aphanidermatum—Fungicidal trials.*—In co-operation with the Indian Council of Agricultural Research trials with a number of new fungicides for the control of damping off were conducted at the Lam Farm, Guntur. Seeds of Virginia tobacco (Harrisons Special) were sown in plots according to the local practice. The fungicides used were Fermate, Dithane, Peronox and Bordeaux mixture (1 per cent). Four sprays were given to the respective plots replicated five times, the first spraying being given twenty days after sowing. The disease was prevalent in all the plots. Dithane had an initial scorching effect on the seedlings. The number of surviving seedlings in the different plots was recorded and the results were statistically analysed. On this basis it was observed that Bordeaux mixture was easily the best and was not equalled by any of the other fungicides. The results are shown below :—

TABLE V.—*Statement showing the number of surviving seedlings under various treatments.*

Treatment.	*Average number of surviving seedlings per plot.*	*Treatment.*	*Average number of surviving seedlings per plot.*
Fermate	83·30	Bordeaux mixture	209·70
Dithane	69·70	Control	48·80
Peronox	133·00		

Critical difference : 120·02.

III. DISEASES OF FRUITS.

1. *Grape vine—Downy mildew* (*Plasmopara viticola*) *and Powdery mildew* (*Uncinula necator*).—Both these diseases were common in Madura district and were particularly severe at Pattiveeranpatti. An experiment was laid out at this place in a private garden to test the relative efficacy of Fermate, Dithane, Peronox and Bordeaux mixture in controlling these diseases. The fungicides were supplied by the Head of the Division of Mycology, New Delhi. According to the original programme three sprays, were scheduled to be given, one after pruning, the second after the flush and the third after fruit set. But as the infection was severe the sprays were applied at intervals of a fortnight. The incidence

of the disease was recorded soon after the last application. The mean percentage of leaf infection was noted, and the results were as shown below :—

TABLE VI.—*Mean percentage of infection of leaves under different treatments.*

Treatment.	Percentage of infection.	Treatment.	Percentage of infection.
Fermate	31·2	Peronox	31·2
Dithane	30·8	Bordeaux mixture	34·1

There was no difference between the treatments. One significant observation was that in tracts where severe infection was usual, the number of application of any fungicide had to be increased to give satisfactory protection.

2. *Mandarin orange—Decline in Wynaad.*—A disease resulting in the gradual decline and death of orange trees is prevalent in Wynaad. A scheme was sanctioned by the Provincial Government for the investigation of this disease and it began to function from June 1948, at Kalpatta, Wynaad. But from the beginning of April 1949 the scheme has received the financial help of the Indian Council of Agricultural Research and is to continue for three years. A survey of the orange gardens in Wynaad was commenced and observations were recorded with particular reference to the incidence of the disease, the soil characters, the aspect of the garden and the cultural and manurial practices followed. It was observed that the decline is present in trees of all ages. The incidence is more in gardens having a southern or western aspect, or where the soil is shallow. In gardens where the soil is exposed to the sun, higher incidence of disease was noticed. The system of manuring adopted in most of the gardens was inadequate.

3. *Isolation of fungi and inoculation experiments.*—In many of the affected trees one or more of the roots were found to be dying. Three fungi have been isolated from diseased roots, viz., *Rhizoctonia bataticola*, *Fusarium* sp. and *Diplodia* sp. Healthy Mandarin plants were obtained from Kallar fruit gardens and from Ambalavayal Wynaad and transported to Kalpatta. Inoculations were carried out on wounded and unwounded roots of healthy plants. Stray cases of infection developed on wounded roots. But most of the plants did not take infection. Further experiments are in progress.

Field experiments.—In order to find out whether the decline is due to defective cultural operations or insufficient manuring, experiments have been started in private gardens with the co-operation of the owners. Mulching by spreading leafy branches over the soil at the base of trees has been tried. The effect of

mammutty digging of the soil as compared to forking or working the top layers alone without injuring the roots is being tested. The influence of application of 10 lb. of groundnut cake, 75 lb. of cattle manure, 1 lb. of super and 1½ lb. of potash per tree per year is being studied as compared with the local practice. Cover crops are being raised and lime is being added to the soil. These operations can produce results only in course of time. Periodic observations are being recorded on the general health of the treated trees. The application of Bordeaux mixture and mixture of sand, lime and copper sulphate to the soil round the crown roots are also being tried to minimize root rot.

Orange disease in Kukal valley.—Gradual deterioration and ultimate death of Mandarin oranges are prevalent in Kukal near Kotagiri. The leaves turn yellow, defoliation results and the plants die. The development of fibrous roots is poor. In many of the gardens intercrops of potatoes and ragi are being raised.

It was suspected from the symptoms that the plants were starving either due to lack of absorption of nutrients from the soil or non-availability of the nutrients in the soil. A preliminary analysis of the soils from the neighbourhood of healthy and diseased plants showed that phosphoric acid and lime were in deficit in the latter sample. It was thought, however, that analyses of the leaves of the two types of plants would give a more correct estimate of their nutritional status. For this purpose, Dr. Patwardhan, the Director of the Nutrition Research Laboratories, Coonoor, was approached for help in spectrographic analysis of the ash of the leaves. He kindly co-operated and with the help of Dr. De of the same institute, 12 samples from each of healthy and diseased trees were collected, ashed and analysed. It was interesting to note that the analyses revealed the deficiency of phosphorous, magnesium, manganese and boron in the diseased plants. In all samples, zinc was absent. These are important elements for oranges. Based on these results, experiments are being laid out in a private garden to supply these deficiencies and note the effect.

IV. Diseases of Vegetables.

Fusariosis of tomatoes, brinjal, cluster beans and chillies.—Wilt diseases of these vegetable crops were common on the Central Farm. In all cases *Fusarium* sp. was isolated from the roots of the affected plants. The isolates were grown in pure culture and the morphological characters studied.

The isolates were inoculated in sterilized soil contained in pots and then sown with the seeds of the vegetables. Pre-emergence infection of seeds resulting in non-germination was noticed in brinjal and cluster beans. Further, post-emergence infection was also recorded in these two and in tomatoes.

In chillies infection was not evident when the soil was inocluated with cultures grown on agar media or sand-oat cultures. Successful

infection was obtained when the soil was mixed with bits of chillie roots overgrown with the pure culture of the isolate. The failure to obtain infection of chillies in previous experiments must be attributed to the use of agar-cultures for inoculation purposes.

V. Agro-Industries.

1. *Ergot of rye—(Claviceps purpurea).*—The scheme for the large scale production of ergot on the Nilgiris was continued. Rye crop was raised in two seasons. About 60 acres were sown to rye in April to May. There was a set back to the crop owing to absence of rains after sowing. About 12 acres of the crop dried up. During the second season about 40 acres were sown of which 8 acres did not flower at all. Thus, only about 80 acres of crop were available for ergot production. These were spray inoculated with the spore suspension. Infection was satisfactory in the early stages. But later the weather brightened up and the development of the sclerotia was affected. These were reduced in size and light in weight. Consequently the total production of ergot suffered considerably. The entire produce amounted to 489 pounds of dry ergot. In some of the plots, seed setting was also poor, so that great difficulty was experienced in obtaining sufficient seed for sowing and preparation of cultures. During 1949 an area of 70 acres has been sown during April to May. The germination and growth are satisfactory so far.

Disposal of ergot.—It was originally programmed to have the ergot processed at the Medical Stores Depot, Madras, into *Ergota preparata* and *Extractum Ergotae liquidum* and supply them to hospitals, etc. With this object 1,202 pounds of ergot had been sent to the Stores in 1948. But owing to the non-availability of solvents, this stock had not been processed. To prevent deterioration of the stock, it was considered advisable to dispose of this quantity to private firms, as there was demand for ergot and to utilize fresh stocks for processing at the depot. Samples of the stored ergot were taken and sent to the indenting firms. Reports of the satisfactory quality of the sample have been received from them and arrangements are in progress to effect sale of this stock at Rs. 20 a pound. It is satisfactory to note that ergot does not deteriorate in 18 months if properly stored.

2. *Food yeast—Torulopsis utilis.*—A pilot plant for large-scale production of yeast was erected in 1948. During the year under report the plant was in operation for 260 days. Minor defects or breakdown of parts of machinery contributed towards stoppage of production during some days. The molasses used for the preparation of the wort were obtained from Pugalur Sugar Factory or on a few occasions from Podanur. The total quantity of food yeast produced during the year amounted to 1,491 pounds. There was good demand for this yeast from hospitals and the public. Over 1,366 pounds have been disposed of. There are standing orders for the supply of monthly consignments of yeast from the

Government hospitals in Madras and Coimbatore and the Mission hospitals at Vellore and Mathurai. Numerous indents from private individuals are also being received.

Training in yeast manufacture.—During the year two persons underwent training in the production of food yeast at the pilot plant. One was a chemist from the Ugar Sugar Factory, Bombay Province. Another was a private candidate from this Province. Both the candidates were charged the prescribed fees.

VI. Grow More Food Scheme.

To help in the drive for increased production of food crops, the Government have sanctioned a separate agency for the control of diseases and pests of crops, who will concentrate their attention on the prompt adoption of suitable remedial measures throughout the Province. Two crop and plant protection officers in mycology have been appointed with headquarters at Coimbatore and Bapatla respectively. To help them in the execution of adequate control measures, one assistant for plant protection (mycology) has been posted to each district headquarters. The special staff is intended to attend to the control of diseases of food crops in particular by helping the ryots in the adoption of remedial measures in time. For this purpose necessary equipment consisting of sprayers and dusters have been purchased and kept for use at strategic centres. Both power-operated and hand operated sprayers and dusters have been obtained. Large quantities of chemicals necessary for the preparation of fungicides, have been stocked at the various depots.

Concentrated efforts were made to control the diseases of rice. Blast was noticed in paddy nurseries at Nellore and Tirunelveli. Demonstration of spraying the nursery with Bordeaux mixture was conducted on 70 acres of nursery. Arrangements have been made to distribute seeds of resistant cultures in the affected areas. In the Tanjore delta the resistant varieties, Co. 25 and Co. 26, are being popularized. Helminthosporiose and foot rot were prevalent in a number of districts. Over 35,000 pounds of seeds have been treated with Agrosan GN. in Coimbatore and Tiruchirappalli districts in order to control these diseases. Further treatment is in progress. Sulphur has been distributed by the plant protection staff for the treatment of sorghum seeds to cover an area of over 30,000 acres. Suitable remedial measures were undertaken for the treatment of diseases of onion, brinjal, chillies, citrus, grapes and sugarcane.

Besides controlling the diseases prevalent at the time on the crop plants, these measures helped in the prevention of further spread of the diseases, to new areas. The ryots were familiarized with the measures to be adopted and the necessity to carry them out in proper time.

VII. Miscellaneous Investigations.

(*a*) *Cinchona diseases.*—At the request of the Director, Cinchona department, the plantations at Anamalais were inspected. 'Damping off' was prevalent in the nurseries. This was found to be due to *Pythium vexans.* Application of Bordeaux mixture was effective in controlling the disease. The plants raised from cuttings were affected by wilt disease. The roots and portions of the stem were infected by *Phytophthora cinnamomi* and *Pythium vexans.* Heavy incidence of root rot, collar rot, stem canker and die back were noticed, in the plantation on plants of different age groups. *Phytophthora cinnamomi* was found associated with all these symptoms. The heavy rainfall of the area is conducive to the development of diseases caused by Pythiaceous fungi. Arrangements have been made to try the effect of stem washing with Bordeaux mixture on the control of the diseases.

(*b*) *Rhizome rot of ginger—Pythium spp.*—In previous years it has been found that treatment of rhizomes with mercuric chloride before storage prevented storage rot, but was not quite effective in controlling the disease in the field. Experiments have been laid out at the Agricultural Research Station, Taliparamba, to observe the effect of rhizome treatment before planting coupled with application of phosphatic manures on the incidence of the disease in the field. Ammonium phosphate and superphosphate have been used. The planting is over and records of germination and incidence of disease are being made.

(*c*) *Dry rot of potatoes—Fusarium coerulum.*—Dry rot of potatoes in storage is common on the Nilgiris during some years. Treatment of tubers is recommended for the control of this rot. Two treatments were tried at the Agricultural Research Station, Nanjanad. One consisted in dipping the tubers in Ceremul emulsion before storage. In the other the tubers were dusted with a substance known as 'Fusarex.' The incidence of dry rot was very low and there was no difference between the treatments. But the tubers dusted with Fusarex exhibited inhibition of sprouting while the untreated ones had very long sprouts. When the seed tubers have to be stored for some months before sowing it as advisable to dust them with Fusarex so that the sprouts may be short and do not become damaged while handling.

(*d*) *Edible mushroom—Volvaria diplasia.*—This mushroom is amenable to cultivation even by amateurs. Consequently the demand for the pure culture spawn of this mushroom is being received from all over India. Good yields have been reported from Pondicherry. Over 170 bottles of spawn were distributed. Fresh isolations of the fungus have consistently produced more mushrooms than older ones. The fungus grows well at 35°C.

(*e*) *Agri Tree-killer solution.*—This preparation is in great demand from ryots and other persons to destroy unwanted tree growth from fields, wells or buildings. Fifty-nine gallons of the solution were sold. Reports from several of the local ryots showed

that this was very useful in destroying *Morinda tinctoria* which is difficult to be eradicated from fields Mr. Nirody has reported that he has successfully destroyed *Millingtonia hortensis* by the use of this solution at the Indian Institute of Science, Bangalore. Both these trees produce numerous root suckers, and it is gratifying to note that the solution is able to destroy these from arable land.

(*f*) *Systematic mycology.*—There is no published 'flora of the fungi' of this province. It is advantageous to have one in order to have an idea of the occurrence and distribution of the different fungi and it will be useful to all persons interested in mycology. An annotated list was prepared. Several unnamed specimens in the Herbarium were examined and the fungi present on named host plants were determined. Larger numbers of fresh collections were made and the parasites identified. Several new species were described. Fifty-four new specimens were added to the herbarium. Type specimens of new species were also deposited in the Herbarium Cryptogamme Indiae Orient at New Delhi.

(*g*) *Arecanut stem breaking.*—Persistent reports of damage to areca palms caused by the breaking of the stem 6 to 8 feet below the crown were being received from South Kanara. Several gardens were inspected. The problem was found to be serious. Examination of the affected trees led to the conclusion that this was not associated with any pathogenic organism. The soil in the gardens was analysed. It was observed that lime and phosphoric content of these soils were low. Spectrographic analysis of the leaves of these areca palms revealed that zinc was not present in any of the samples.

Based on these observations experiments are being laid out in private gardens to test the effect of supplying lime and phosphatic manures and spraying zinc salts on the growth of the palms.

VIII. Teaching.

Thirty-three lectures and forty-four practical classes were held in Mycology and Plant pathology for the final year students of the B.Sc.Ag. course. Demonstrations of the structure of fungi and the manner in which they affect plants were made to the students of the forest college. Batches of students from various educational institutions, and from the Agricultural College, Bapatla, were shown round the section and the activities of the section explained to them. Over 50 plant protection assistants were trained in batches for one month each on the identification of the chief diseases of crops and methods of controlling them. They were given practical training in the preparation of fungicides and the use of sprayers and dusters. Several specimens of plant diseases and cultures of fungi were supplied to workers in this province and other parts of India. There were several changes in the subordinate staff and freshmen were being posted to the section. This necessitated constant attention in the training of the new assistants in methods of phytopathological research.

IX. Propaganda.

Special charts and posters were prepared and distributed to some of the district staff. Posters on Ergot production and yeast manufacture were made and sent to the Madras Industries Association, Madras. The section participated in a number of exhibitions and shows by sending specimens and posters. Members of the staff were deputed to attend the All-India Khadi and Swadesi Exhibition, Madras and the Agri-Horticultural Flower and Fruit Shows at Ootacamund and Madras respectively. Articles on the symptoms and methods of control of diseases of crops were published in the Villagers' Calendar and in the departmental journals.

X. Plant Quarantine, Legislation and Advisory Work.

Several consignments of tamarind, cardamom, pepper and seeds and live plants of different species intended for export were examined for freedom from disease causing fungi and phytosanitary certificates were issued when they were found to be healthy. Imported plant materials were examined at the port of entry and allowed into the country if found to be free from diseases. Otherwise they were destroyed at the ports.

The Agricultural Pests and Diseases Act was in operation in respect of the following diseases in different parts of the Province :—

(1) *Bud rot of palms.*—The Act was enforced in the districts of East Godavari, West Godavari, Krishna and three taluks of Malabar. A special staff was in charge of the enforcement of the Act in the three northern districts. The Sub-Assistant in mycology assisted by three revenue inspectors carried out the work in Malabar.

(2) *Sugarcane smut.*—The Act in respect of this disease was in operation in the Hospet taluk of Bellary district. A special Agricultural Demonstrator with the help of field staff enforced the Act.

(3) *Mosaic of cardamom.*—Nelliampathy hills in the Malabar district formed the notified area and entry of cardamom rhizomes from outside into this area was banned.

(4) *Spike disease of sandal.*—Hosur and Dharmapuri taluks comprised the notified areas. The Act was enforced by the District Agricultural Officer, Salem and the Forest department.

(5) *Ban on the summer wheat cultivation.*—The cultivation of wheat in any part of the Province has been banned between the 1st of April and 30th September 1949. So far no sowings have taken place.

One hundred and thirty-six specimens were received from different parts of the Province and some planters. These were examined, the diseases identified and suitable control measures recommended. Several gardens and estates were visited at the request of the parties to examine the incidence of diseases on the spot and suggest protective operations.

Pure cultures of over 60 species of fungi were maintained and made available to other workers as and when required.

XI. Miscellaneous.

Publications.—The following papers were sent up for publication during the year under report :—

(1) Additions to the Fungi of Madras—VI. By T. S. Ramakrishnan and K. Ramakrishnan. Proc. Ind. Academy of Sciences —Vol. 28—1949.

(2) Additions to the Fungi of Madras—VII. By T. S. Ramakrishnan and K. Ramakrishnan (in the press).

(3) Additions to the Fungi of Madras—VIII. By T. S. Ramakrishnan and K. Ramakrishnan (in the press).

(4) Studies in the Genus Colletotrichum IV. By T. S. Ramakrishnan. Proc. Ind. Acad. Sci. 28—1949.

(5) Investigations on Cereal Rusts 1—*Puccinia penniseti*. By T. S. Ramakrishnan and C. K. Soumini. Indian Phytopath—Vol. I—No. 2.

(6) Investigations on Cereal Rusts 2—*Uromyces setariae itlicae* By K. Ramakrishnan—Ind. Phytopath—Vol. II—No. 1.

(7) Investigations on Cereal Rusts 3—*Puccinia purpurea*. By C. K. Soumini. Ind. Phytopath—Vol. II—No. 1.

(8) Banded Sclerotial Disease of *Maranta arundinacea*. By T. S. Ramakrishnan and K. Ramakrishnan—Ind. Phytopath—Vol. I—No. 2.

(9) *Pythium Vexans* in South India. By T. S. Ramakrishnan. Ind. Phytopath—Vol. II—No. 1.

(10) *Chaconia Tectoniae*—By T. S. Ramakrishnan and K. Ramakrishnan. Ind. Phytopath—Vol. II—No. 1.

Acknowledgment.—I am very grateful to all my colleagues at Coimbatore and the districts for the ready help and co-operation extended. My thanks are due to Dr. Patwardhan and Dr. De of the Nutrition Research Laboratory, Coonoor, for their ready help in the spectrographic analysis of plant tissues. I have great pleasure to place on record the ungrudging help and devotion to duty of the members of my staff.

COIMBATORE,
30th July 1939.

D. MARUDARAJAN,
Government Mycologist.

APPENDIX.

Name of service and post.	Number of sanctioned post.	
	Permanent.	*Temporary.*
I. *Madras Agricultural Service.*		
1 Government Mycologist	1	..
2 Gazetted Assistant in Mycology	..	1
3 Assistant Mycologist (Paddy Scheme)	..	1
4 Assistant Botanist (Cardamom Specialist)	..	1
5 Assistant Entomologist (Cardomom Scheme)	..	1
6 Assistant Mycologist (Ergot Scheme)	..	1
II. *Madras Agricultural Subordinate Service.*		
1 Upper subordinates	8	5
2 Lower subordinates	1	..
3 Fieldmen	4	5
III. *Madras General Subordinate Service.*		
1 Laboratory attenders	2	3
IV. *Madras Ministerial Service.*		
1 Lower Division Clerks	2	2
V. *Madras Inferior Service.*		
1 Peons	4	4

ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR THE YEAR 1948–49.

DETAILED REPORT.

I. Charge.

I was in charge of the section during the year under report.

II. Staff.

Sri E. R. Gopala Menon, Assistant Entomologist, Teaching, was transferred as Crop and Plant Protection Officer (Entomology), Coimbatore and Sri M. S. Subbiah, Assistant Entomologist, Singampatti, was posted in his place. Sri K. R. Nagaraja Rao, Assistant in Entomology, was transferred to the Agricultural Research Station, Siruguppa and Sri T. B. Krishnaswami Rao, Agricultural Demonstrator, Mudukur, was posted in his place. Sri S. M. Shankar Rao, Assistant in Entomology, was relieved on 10th July 1948, since Sri C. K. Subrahmaniam joined duty on the expiry of his leave. Sri G. V. Babu Rao, Agricultural Demonstrator, under training, was posted as Assistant in Entomology, *vice* Sri C. K. Subrahmaniam granted leave again. Miss Girija Lakshman, Assistant, was transferred to the Government Lecturing and Systematic Botanists' Section and Sri D. Meenakshisundaram transferred to her place. Consequent on the retirement of Sri C. K. Subrahmaniam in January 1949, Sri T. R. Subrahmaniam was transferred from the Cotton Specialist's Section, to officiate in the vacancy. Sri V. T. R. Rajagopalan, Assistant in the D.D.T. Scheme was transferred to the Indian Central Sugarcane Committee Scheme, Nellikuppam, and Sri K. R. Nagaraja Rao transferred from Sirguppa to his place. Sri T. B. Krishnaswami Rao, Assistant, was transferred to the district and Sri T. S. Muthukrishnan was appointed in the vacancy. Sri D. Meenakshisundaram was transferred to the Paddy Section and Sri S. Venugopal posted in his place. The services of Sri N. Muthuswami Nayudu, Assistant, were spared to the Government of India. The control of the Artists' Section was transferred to the Principal, Agricultural College and Research Institute, Lawley Road P.O. Sri P. V. Narayanan, Fieldman, was temporarily transferred to the Agricultural Research Station, Pattambi. Sri A. R. Seshadri, Research Fellow in Entomology, consequent on his selection as Assistant Entomologist, was relieved on 22nd March 1949.

III. Leave.

Sri C. K. Subramaniam, Assistant in Entomology, was granted leave on average pay preparatory to retirement. Assistants Sri V. T. R. Rajagopalan, Mrs. A. Leela David, Miss I. P. Janaki and Sri K. C. Chandy and Artist Sri E. William, Albert, were granted earned leave for various periods.

IV. Tours.

Myself and the staff were on camp for varying periods for the investigation of crop pests.

V. Advisory.

Numerous enquiries were received for help regarding the control of crop pests as well as on bee-keeping. Most of the items of the latter category were attended to by the Section, while the former were transmitted to the recently appointed Plant Protection Officer.

VI. Teaching.

(i) *B.Sc. (Ag.).*—The number of classes conducted for the B.Sc. (Ag.) first and second years, bearing on Economic Zoology and Entomology was as follows :—

	Lectures.	*Practicals*
Class I	53	56
Class II	26	46

(ii) The University Examinations were conducted. The Internal Examiners Sri K. P. Ananthanarayanan and Sri M. S Subbiah worked in co-operation with the External Examiners. Sri V. Tirumala Rao and Sri M. C. Cherian for second and first year classes respectively.

VII. Investigations of Crop Pests.

The period under report was characterised by phenomenal outbreaks of some of the major pests of food crops in different parts of the Presidency, requiring immediate and effective attention. The recent discovery of the two wonder insecticides—DDT and BHC—proved to be a real and timely boon. These two chemical were adopted for use against crop pests and very convincing results were obtained in most cases. What is more interesting is that the ryots have spontaneously realized the efficacy of these chemicals and enthusiastically adopted the departmental advice mostly at their own cost, wherever it was necessary. Experiments on the efficacy and adaptability of these two chemicals against various crop pests constituted one of the major items of research for the year. The results were in most cases far beyond our expectations and the advent of these two insecticides may, therefore, be considered as a landmark in the progress of the section. Short accounts of the same are furnished in the appropriate places.

1. *Pests of sugarcane* (*Indian Central Sugarcane Committee Scheme*)—*Argyria, Diatroea and Scirpophaga.* Investigations on *Argyria sticticraspis, H., Diatroea venosata, W.*, and *Scirpophaga sp.*, the main borer pests of cane, were in progress, under two categories. The first aspect deals with the study of : (1) the influence of the weather factors, macro and micro-climatic conditions, etc., on the population of the borers, (2) mortality and compensation

Indices, (3) alternate host plants and (4) cultural and insecticidal methods of their control. The other line of research was restricted to the intensive colonization trials with the egg-parasite—*Trichogramma*—as a measure of control against *Argyria*.

(*a*) *Study of the borer pests.*—The observations were made on cane varieties Co. 413, 419 and 421 as in the previous years, in the Central Farm fields. The varieties were planted in 5 cent plots with outskirts of 3 cents all around, each variety being replicated six times. The planting was done by April 1948. Estimation of the infestation and population of the three borers was made on plants dug out at random from about 3 per cent of the total area, commencing from the sixth week after planting and continued up to the harvest of the crop. Details of the species of the borers and their measurements were recorded. Meteorological observations consisting of general weather factors, maximum and minimum temperatures, velocity and direction of the wind, evaporation index and rainfall were recorded once a day. The relative humidities as well as the micro-climatic readings inside the crop for each variety were recorded separately twice a day. The averages of the weather data were calculated for every 21 day period, for collecting their influence on the borer population.

The main borers of the sugarcane at Coimbatore are—

(1) *Argyria sticticraspis, H.*, the early shoot-borer.

(2) *Diatroea venosata, W.*, the stem borer.

(3) *Scirpophaga sp.* the top shoot borer.

(1) *Argyria sticticraspis, H.*—This is more a pest of the young crop and hence known as the early shoot borer. The damage starts from the germination of the buds and continues up to June-July, the percentage of infestation reaching its peak during the later stages. The maximum damage and the calculated population of the borers were 25·1 per cent, 29·3 per cent and 25·6 per cent and 3,432, 3,479 and 2,761 for Co. 413, 419 and 421 respectively during the year.

(2) *Diatroea venosata, W.*—With the cessation of the incidence of *Argyria* by June-July, the second borer commences its activities on the young canes, which are just formed by about this period and continues to appreciate till the harvest of the crop. The highest percentage of damage was recorded during December January and the details are 24·1, 33·8 and 29·3. The calculated borer population per acre was 1,092, 1,300 and 1,508 for the three varieties respectively.

(3) *Scirpophaga sp.*—Contrary to the experience of the previous years, this borer was somewhat more prominent during the current year, on Co. 413, the range of infestation being 3·5 to 10·7 per cent.

Influence of weather factors on borer population.—The indications of the previous year's observations are that high temperatures

and low humidities with a few sharp showers during summer were congenial for the mutiplication of *Argyria*, whereas low temperatures and high humidities were very favourable to *Diatroea*. This year's experience was found to be in general agreement with that of the previous years in the case of *Argyria*, but not entirely so for *Diatroea*. As regards *Scirpophaga* no correlations could be traced with the weather factors, as the incidence of the pest was erratic and distributed throughout the season.

(*b*) *Micro-climatic studies.*—The variations in the micro-climatic readings inside the crop were not very convincing in any of the three varieties and as such no correlations were indicated between micro-climatic factors and varietal susceptibility.

(*c*) *Mortality and compensation indices study.*—The plots were laid out as per instructions of the sugarcane Specialist, Bihar, and the studies commenced from 1st June 1948. The mother plants were marked out first. The dates of the emergence of the subsequent tillers and mortality, if any, among them with the causal agents also were recorded every fortnight till the crop matured. Observations on the number of canes per clump, length and the number of nodes affected by each borer, etc., were made before harvest. The harvested canes were crushed unit-war and the juice analysed for sucrose content, purity and brix. The period of active tillering was found to extend up to the end of July with the maximum during June. The tillers which had emerged up to the end of June matured into canes and the rest either wilted away or developed into water-shoots. The total number of mother plants produced was 375, 390 and 369 and the average number of tillers produced per mother plant was 7·1, 4·5 and 5·6 for Co. 413, 419 and 421 respectively. The aggregate mortality in each variety due to the borers, jackals, wilting, etc , was found to be 5·6, 3·6 and 3·8 leaving a balance of 1·5, 0·9 and 1·8 per mother plant, which matured into canes. The records concerned with these studies were sent to the Secretary Indian Central Sugarcane Committee, New Delhi.

(*d*) *Examination of alternate host plants.*—A number of grasses and weeds growing in the vicinity of the sugarcane areas were periodically collected and examined for borer infestation to study whether they harbour any of the borers during the off-season. The following plants were examined. *Saccharum spontaneum*, *Echinocloa colona*, *Eleusine aegyptiaca*, *Pennisetum Hockenhackeri*, *Chloris barbata*, *Imperata cylindrica*, and *Cyperus rotendus*. Of these only *Saccharum spontaneum* harboured a few larvae of *Diatroea* and *Scirpophaga*.

(*e*) *Natural enemies.*—No new additional information has been obtained this year.

(*f*) *Control measures*—(i) *Earthing up of young plants against Argyria.*—The object was to study whether the loose earth thrown up would smother the young caterpillars and eggs which are invariably found on the underside of the lower leaves. Experiments

were taken up in 5-cent plots with appropriate controls. Three earthings were given at intervals of one month. The earthed-up plots showed a significant decrease in the number of deadhearts as compared with the control, but the yields were not proportionate since the latter gave an additional quantity of 1·4 tons of canes per acre.

(ii) *Digging out crop residues* versus *cutting at ground level.*—These experiments were planned to study whether (1) the tonnage can be increased by including the underground portions of the canes, (2) the method, if economical, can also be practised to eliminate the breeding of the borers during the offseason. The experiments were conducted at Nellikuppam in 5-cent plots with eight replications. An additional yield amounting in money value to Rs. 67-4-0 per acre was obtained but the limiting factors to practise this method on an extensive scale are the non-availability of labour during rush of the harvest season and the common local practice of ratooning the crop.

(iii) *Insecticidal trials.*—As during previous years, four sprays of DDT and BHC at 0·25 per cent concentration were given at intervals of one month against *Argyria* commencing from the fourth week after planting of the cane. Initial and subsequent counts of the deadhearts were taken prior to the first spraying and at intervals of 21 days between the treatments, till the damage ceased to occur. The results were found to be in favour of DDT, as the plots showed a significantly lesser number of deadhearts. But the yields were disappointing since the treated plots yielded 1·43 and 1·29 tons less than the control in the case of DDT and BHC respectively.

(iv) *Trichogramma colonization trials.*—An intensive colonization of these parasites was made to investigate the possibilities of utilizing them to control *Argyria* in its egg stage and the releases were confined to the season of high egg-laying activity (May-July) by this borer. The parasites were bred in their millions at Coimbatore on the eggs of the *Corcyra cephalonica* and the parasitised egg-cards sent to Nellikuppam by post. The adults were released on their emergence in the fields of The East India Distilleries and Sugar Factories, Limited, Nellikuppam, in 3 acre blocks, replicated four times. Twelve weekly releases were made commencing from 29th April 1948 and completed by 16th July 1948 at the rate of 16,000 parasites per acre per release. Periodical counts show that the activities of the parasite were higher in the treated plots, the percentage being 32·2 as against 17·3 in the controls. The data also reveal that the borer population and damage were kept under check in the treated plots. They also gave an additional yield of 4·49 tons per acre over the controls valued at Rs. 188-10-0. The cost of the releases works out to about Rs. 50 per acre and the net gain in money value therefore is computed as Rs. 138-10-0 per acre.

(*g*) Besides the scheme work, investigations were also conducted on insecticidal methods of control of the following two major pests of sugarcane and very encouraging results were obtained :—

(i) *The cane fly* (*Pyrilla perpusilla, W.*).—This is one of the major pests of sugarcane occurring more or less regularly in parts of South Kanara and sometimes at Coimbatore, South Arcot, etc. The bugs appear in their swarms on young as well as grown-up crops and suck up the juice. These insects have also the habit of secreting large quantities of a sticky and sweetish fluid on which the dark-coloured fungus—*Sooty mould*—develops. The infested plants are stunted in growth, look sickly and yellow, the dark sooty mould adding to the miserable appearance. Very little was so far possible towards the control of this pest except by mechanical methods. Recent trials with BHC D. 025 and Hexyclan 5 per cent have revealed the possibilities of controlling the pest and definite results were obtained in one or two field trials. A few ryots also under-took to treat their fields at their cost.

(ii) *The cane grasshopper* (*Hieroglyphus sp.*).—These hoppers occasionally appear in a severe form on sugarcane in the Visakhapatnam district and the present year witnessed a particularly severe incidence on a cane crop at Bobbili. Vast areas were affected and there were urgent calls for help. Hand-netting the insects being out of question, BHC D·025 was tried as an experimental measure and the results were very convincing as a very high mortality of the hoppers was observed. The local Sugarcane Growers' Co-operative Society, which has vast areas under its aegis is reported to have taken full advantage of these results and arranged for treating the infested fields on their own account.

2. *Pests of paddy.*—The investigations under this heading comprise of the continuation of the work of the previous years, with the addition of a number of new items of considerable interest.

(*a*) *The paddy stem-borer* (*Schoenobius incertellus, W.*).—Attention was concentrated on this borer at Coimbatore, Pattambi and Aduthurai. *At Coimbatore*, a periodical search for the larvae and egg-masses was continued. Observations on 2,674 deadhearts containing 321 larvae did not reveal any parasitic activity, while the egg-masses were parasitized up to 52·4 per cent by *Telenomus sp.* and *Trichogramma sp.* during the month of December. Attempts to utilize these parasites for the control of the pest were fruitless as they refused to thrive under artificial conditions. *At Pattambi*, major emergences were found to occur during the months of November and December with a considerable overlapping of the broods. *At Aduthurai*, the early crops, viz., "Kuruvai" and "Samba" escaped the pest, while "Thaladi" was subject to a fairly severe damage, careful observations on the course of the borer have shown that the initial infestation takes place in the nurseries during September. The progeny of this brood re-infests the crop at the

shot-blade stage in the field—during November–December causing the characteristic deadhearts. Light traps were tried regularly but these contrivances do not appear to have given any appreciable relief except for indictaing the mass emergences. Based on the information gathered during the current year, it is proposed to take up some insecticidal trials at the critical periods during the ensuing season.

(*b*) *The paddy mealy bug* (*Ripersia oryzae, G.*).—This pest has been under study for the past few years, but has not, so far appeared in a sufficiently virulent form as to enable us to correctly asses the results of the control measures. Scorching of the nursery bunds, application of DDT and BHC, etc., on the seedlings to prevent the initial infestation did not give any conclusive results. The work is under progress.

(*c*) *The paddy gall fly* (*Pachdiplosis oryzae, W.*).—This is a small fly causing the characteristic tubular malformation of the central shoots of the paddy plants. Eggs are laid on the tender plants and the maggots on hatching, bore into the central shoots. The gall or tubelike structure is a result of the internal irritation. The infested tillers do not bear and the loss is often severe. Irtensive observations were conducted at Ungattur, a village in Krishna district, where the pest is rampant. A compact area of 90 acres was selected and 16 light traps were permanently installed in half the area with a distance of about 80 yards between two lights, leaving the other half as control. The work was commenced by August and closed by November. Daily counts of the flies attracted to each light as well as the fortnightly progress of the infestation in the field were regularly recorded in the treated and control plots. The broad conclusions of the trials are that heavy emergences of the flies occur during September and October and that they are not attracted to lights during moonlight nights. In cases of severe damage only two or three tillers escape the damage in each clump and the average loss is computed to be two to three bags per acre. The infestation data were analysed and the reduction of the damage was found to be statistically significant in the light-trap area.

(*d*) *The paddy grasshopper* (*Hieroglyphus banian, F.*).—Alarming reports were received by the end of September about a severe incidence of this grasshopper over an area of 2,000 acres in the Gudivada and Gannavaram taluks of Krishna district. Enough is already known about the habits and depredations by this pest and as such only a short account of the experiments done and of the results obtained towards the control of this pest is furnished below. The approved methods advocated so far were scraping the bunds during January so as to expose the egg-capsules and hand-netting the adults. It was too late to practise the former and as the latter method was impracticable, some efficient measure had to be immediately devised and pouplarized to meet the extremely emergent situation. The possibilities were, therefore, confined to insecticidal methods. The available chemicals—BHC and DDT

were rushed to the spot and trials initiated immediately. The specific action of BHC—both as spray and dust—was definitely indicated as it caused a complete mortality of the hoppers within about 12 hours. Between the two forms of the chemical, the dust was cheaper and easier to apply. The quantity required for an acre was about 20 lb. costing Rs. 10. The good news spread like a wild fire all over the tract and there was an immediate and enthusiastic demand for the insecticide. Every available source for the chemical as well as the applicances were immediately tapped and in all 110 cwt. of Gammexane, 8 crank dusters and one power duster were procured expeditiously and an area of about 800 acres was treated within a fortnight, entirely at the cost of the ryots at full rates. It is roughly computed from the statement of the ryots, who had used this chemical that they stood to gain by about five bags of paddy per acre costing Rs. 60 and the overall benefit accrued to the tract, deducting the cost of the chemical, is estimated to be Rs. 40,000. The campaign had to be closed by October with the crop coming into shot-blade and the onset of the north-east monsoon. The efficacy of the treatment against the hoppers has been definitely established and hardly any more propaganda is necessary in the line except for the arrangements in stocking and the supply of the chemicals and appliances to the ryots in time, in case there are any more outbreaks.

(*e*) *The paddy jassid* (*Nephotettix bipunctatus, F.*).—This is a minute green-coloured bug which was till recently only a minor pest. The insect, however, assumed a major role during the current year and caused an enormous havoc practically all over the Tamil Nad. Almost in the wake of the successful conclusion of the grasshopper problem by October in the Circars, urgent calls for help against this jassid were received from Chingleput by the end of the same month. Further reports, all equally alarming, quickly followed from South Arcot, Salem, Coimbatore, Tiruchirappalli, Mathurai, Tirunelveli, Chittoor, etc. The situation was once again serious and the resources of the section were at no time more pressed into service than on this occasion. The pest was particularly severe on young transplanted crops raised in small patches under well irrigation. The damage was so severe that the entire foliage withered away and a good number of the ryots had ploughed up their fields out of sheer helplessness. Here also the approved methods were only the setting up of light traps to attract the bugs and hand-netting, which were in no way convincing. Insecticidal trials with various combinations and concentrations of DDT and BHC were immediately instituted under my personal supervision at Coimbatore. Much to our relief, DDT 550 spray 0·1 per cent gave spectacular results causing an entire mortality of the bugs in the course of three days. The treatment was cheap as it required only 2 lb. of the chemical per acre costing Rs. 6. As in the case of the grasshopper, the results of the field trials were spontaneously transmitted to the ryot and the response was very encouraging.

(*f*) *The rice bug* (*Leptocorisa acuta, T.*).—This is another pest which is somewhat chronic to parts of Coimbatore, Malabar, South Kanara, etc. The adults and young appear in their millions at the milky stage of the earheads and suck up the juice from the tender grains. These, in their turn, become mere chaff and the loss thus caused is often serious. Hand-netting the bugs has been advocated till now as the only remedy. The method, though efficient, was somewhat laborious and cumbersome and as such only the enlightened ryots could be induced to take it up. Trials with DDT and BHC dusts have shown that the latter is very effective, since it exterminates the entire pest population in the course of a few hours. About 20 lb. of the chemical are required to dust an acre and the cost is about Rs. 10. The use of this insecticide becoming rapidly popular.

(*g*) *The striped bug* (*Tetroda histeroides, F.*).—This is a sporadic pest, occurring in parts of Coimbatore, Salem and Tiruchirappalli. These bugs suck up the juice from the plants and cause their wilting. The damage is often serious in the infested patches. The section has so far been equally helpless in controlling the pest, but the application of BHC D 025 was successful in this case also. Incidentally a new method of control with the help of ducks also came to light. A flock of about 1,000 ducks was able to clear a badly infested patch of about 13 acres in the course of one or two days, each bird accounting for about 500 bugs in the course of a day. The birds were none the worse for their unusual diet.

(*h*) *The paddy thrips* (*Thrips oryzae, W.*)—*Indian Council of Agricultural Research.*—The experiments were conducted at the Central Farm paddy nurseries. DDT and BHC were sprayed at concentrations of 0.25 per cent, 0.1 per cent and 0·05 per cent and the results compared with the standard insecticide—tobacco decoction—1 in 6—. The first two concentrations of the two chemicals and tobacco were all found to be equal in their efficacy.

(*j*) *The field rat* (*Cunomys Kok*).—This is another pest, which received serious study. The common field species consist of the mole rat—*Gunomys Kok*, the Gerbil—*Tatera cuvieri*, the grass rat—*Millardia meltada* and the field mouse—*Leggada booduga*. Of these, only the first mentioned—the mole rat—(*Gunomys Kok*)—is about the most destructive, attacking almost all cereals, millets, vegetables, etc. This rodent generally excavates tortuous burrows in the field bunds extending up to 30 to 40 feet in length and going down to a depth of 4 or 5 feet. The course of the tunnels is frequently blocked with earth. These rats live singly but are in litter from November to February. They attack the paddy crop right from the seed-bed to the harvest stage. The damage caused is often considerable, since some of the individuals were capable of hoarding about 5 lb. of grains in their burrows. Apart from robbing the grains, they also cause an enormous loss by cutting down the plants in shot-blade for the sake of the sweet juice exuding from the plants at this stage. Various methods of control such as

fumigation of the burrows with calcium cyanide, use of bow traps catching the rats by professionals, poison baits, etc., were investigated. Calcium cyanide, though a very effective fumigant, had its own limitations in this case, as the poisonous gas was unable to permeate into the innermost labyrinths, mostly due to the tortuous nature of the burrows and the frequent blockings. Further a good number of the burrows are generally untenanted and as such the poison pumped into them was an obvious waste. On account of these inherent defects, the fumigation was more often a failure and where it was successful, the actual cost of killing a rat sometimes ran up as high as 6 annas. Setting up of bow traps was comparatively simpler and cheaper. About 50 of these contrivances were regularly set up every day at Aduthurai and the daily catches averaged to twenty. Calculating the expenditure on the equipment, labour, bait, etc., the cost per rat averaged to one anna. There is also a local practice of allowing the professional rat hunters to catch the rodents at a flat contract rate of 1 to 2 annas per rat. Trials with poison baits were also conducted to assess the relative merits of the different methods of control. The much advertised rat poison 'Antu' was not of much avail. Experiments were, therefore, concentrated on the rodenticide—Zinc phosphide—and the results were far beyond our expectations. Even a 5 per cent concentration of the poison with puffed or cooked rice caused a very high mortality. The method was popularized in the Northern Circars. Over 2,000 lb. of the chemical enough to treat 20,000 acres were sold in that tract. This is probably the only measure, which promises to be infallible against these troublesome animals and further experiments to simplify the process are in progress.

3. *Pests of cholam and cumbu*—(*a*) *The cholam earhead bug* (*Calocoria angustatus, L.*)—*Indian Council of Agricultural Research*.—This is a notorious pest having a Presidency-wide distribution. It generally infests irrigated crops, but dry crops also are not exempt from its attention. The insect is a small, active, green bug and is commonly found on the earheads. Stray adults occur, when the crop begins to flower, but within an incredibly short time they multiply to such a degree that the earheads literally teem with hundreds of the nymphs and adults causing a severe drain on the cell-sap. Formation of healthy grain is prevented and the damage caused is sometimes very serious. Intensive research on the control of this bug has been in progress at Guntur and Coimbatore for the past three years. Small-scale trials with 3, 4 and 5 per cent of DDT and BHC and Nanjanad clay and large-scale experiments with 2 per cent concentrations were the main lines of work. The following are the broad conclusions arrived at during the course of the work. (1) The irrigated crop-Chitrai cholam—invariably escapes the damage in Coimbatore, if it is sown before the 15th March. (2) Both BHC and DDT definitely control the insect but the former has a quicker knock-down and a more thorough effect. (3) The chemicals are quite efficient even

at 2 per cent concentration and the higher strengths do not, therefore, seem to be necessary. Data regarding the yield were somewhat erratic as they mostly depended upon the virulence of the pest. In individual cases of bad infestation, the additional yield has been as high as 84 per cent over the control and the trends have uniformly been in favour of BHC.

(*b*) *The cholam shoot fly* (*Atherigona indica, M.*).—This fly is peculiar to the Ceded districts and investigations were conducted at the Agricultural Research Station, Siruguppa. Details regarding the life-history of the fly were worked out. The infestation commences from about the 15th day after sowing and extends up to the fifth week after which the pest ceases to occur. A certain amount of varietal resistance was perceptible. Type numbers M47-3, M35-1 and PB2R were fairly resistant, while AS-2095, 5847, etc., were more susceptible. Dusting trials with DDT and BHC at the different stages of the young crop did not give any conclusive results. The best and cheapest method of control, for the time being, appears to be sowing at a higher seed-rate and subsequently thinning out the infested plants.

(*c*) *Surface grasshopper—Chrotogonus sp.* and *Aelopus sp.—on cholam.*—These two species occasionally take to the germinating cholam crop and nip the tender sprouts. They flared up into prominence in a village near Coimbatore and advantage was taken of this opportunity to try DDT, BHC and Hexyclan. The latter two, which have Benzene hexachloride as the active ingredient, were found to have a specific action against the grasshoppers causing a wholesale mortality, while DDT was practically inert.

(*d*) *Thrips on cumbu* (*Thrips sp.*).—This was another new experience during the year as the pest has not, so far, been recorded on this crop. BHC D.025, DDT, 3 and 5 per cent were tried and the results compared with tobacco, the standard insecticide used against thrips. Here again BHC D.025 was found to cause nearly 90 per cent mortality, while the others were not so promising.

4. *Pests of vegetables.*—Besides the pests tackled during the previous year, a few more important items were taken up during the current year.

(*a*) *The brinjal Epilachna* (*Epilachna sp.*)—*Indian Council of Agricultural Research.*—This is one of the major pests of brinjal, the adults and grubs of which occur in large numbers and scrape away the entire leaf surface. Dusting or spraying with calcium arsenate is the approved method of control and trials were instituted to see whether the method could be improved by the use of DDT or BHC. Experiments with various concentrations of the two chemicals have been in progress for the past three years and the results were compared with those of calcium arsenate. It was found that DDT both in the form of spray and dust has a specific action against this pest, while BHC is not so effective. The broad indications are that DDT also can be used in the place of calcium arsenate, if it is necessary.

(*b*) *The chillies thrips* (*Scirtothrips dorsalis H.*)—*Indian Council of Agricultural Research.*—These are minute insects occurring in numbers on the tender shoots and flowers, lacerating the tissues and sucking up the cell-sap. A study of the comparative merits of the different combinations of DDT and BHC as against tobacco has been in progress in properly laid-out field trials for the past three years at Guntur and Coimbatore. Both the chemicals were found to be capable of reducing the insect population, but BHC appears to be a specific against the pest. The variations in the yield which invariably depend upon the severity of the infestation were found to range from 20 to 71 per cent at Coimbatore and 2·0 to 21·0 per cent at Guntur, both DDT and BHC scoring over tobacco.

(*c*) *The bhendai jassid* (*Empoasca devastens, D.*).—This is a serious pest attacking a variety of paying crops such as cotton, bhendai, brinjal, etc. The leaves turn yellow on account of the heavy drain on the cell-sap and the infested plants remain stunted and do not progress at all. The adults and nymphs are rather difficult to get at with contact insecticides and as such the pest was a major problem so far. Dry and aqueous forms of DDT and BHC were tried and the results assessed for effects on the population and increase in yield. DDT dust 5 per cent and spray at 0·1 per cent caused a cent per cent reduction of the insects and the yields also were proportionately encouraging, DDT dust giving 750 per cent and the spray 400 per cent over the control. The jassids do not seem to be affected at all by BHC. Apart from the efficacy of DDT, the yield figures also present a clear picture of the damage these jassids are capable of inflicting, since the infested plants remain stunted in growth and ultimately wither away.

(*d*) *The tomato borer* (*Heliothis obsoleta, F.*).—Though these caterpillars are generally serious on bengalgram, they also have a wide range of hosts of which tomato is one. They bore into the fruits and ruin their quality. Similar trials as conducted in the previous case were taken up. The indication of the results are that the infestation was uniformly low in the plots treated with the insecticides, the range being 1·03 per cent to 1·5 per cent, while the controls had a 7 per cent damage. An additional yield of about 30 per cent over the control was recorded in the case of BHC D.025. The experiments are being continued.

(*e*) *Onion and garlic thrips* (*Thrips tabaci, L.*).—These are small insects which have practically baffled all our attempts so far. They are very minute in size and invariably live inside the whorls lacerting the tissues and feeding on the plant sap. The damage is often severe. The infested crops are generally left to themselves, since we were, so far, practically helpless against the pest. Recent trials have, however, revolutionized the method of control and given us hopes to tackle the problem successfully. The new insecticides—DDT and BHC—were tried in different forms against this insect also. BHC spray even at a low strength of 0·1 per cent was found to cause a considerable reduction of the insects, while

DDT came next. These findings are of immense benefit to the garlic growers, as the crop gives a very decent outturn, if it is saved from the annual depredations of this pest. The ryots too have been very quick in taking up this insecticide and the use of it is likely to become one of the regular practices in course of time.

5. *Pests of fruit trees.*—A few additional items of interest were under investigation during the current year—

(*a*) *The pomegranate butterfly* (*Virachola isocrates, F.*).—This is a serious pest, which has been exceedingly difficult to control so far. The adult lays her eggs on the tender fruits and the larvae on hatching, bore inside feeding on the internal matter. The affected fruits are practically ruined and the loss is sometimes very heavy. Many a garden round about Coimbatore has either been abandoned or cut down because of this pest. Exploratory trials with spraying BHC gave some indicative results and encouraged by these, field-scale experiments have since been laid out to study the comparative merits of DDT and BHC.

(*b*) *The ber fruit fly* (*Carpomyia vesuviana, B.*).—This fly pest has been under investigation in this Section for over a decade. It is serious on the budded varieties in the Kurnool district. The flies are reported to emerge by about July synchronising with the mass flowering of the trees. Being endowed with a long period of adult life, they wait until the fruits set and develop and infest them subsequently. Eggs are laid inside the half-grown fruits and the maggots on hatching bore into the pulp. In due course the full-fed maggots drop on the soil and pupate at a depth of 2 inches. Successive minor broods emerge later and infest the fruits in their turn. After various trials based on mechanical and chemotropic principles and poison baiting, raking up the soil round the trees and exposing the pupæ was evolved as the best method. Some of the ryots gave fair trials to this practice but subsequently gave it up as it was not of much use under the local conditions.

Exploratory trials were conducted with DDT and BHC on the few trees available at the College Orchard. The chemicals were applied in the form of spray once a fortnight. From the observations made so far, it is evident that the sprayed trees are definitely bearing more fruits than the control. Observations regarding details of infestation are in progress. Large-scale field trials have recently been taken up at Panyam (Kurnool district).

(*c*) *The mango hopper* (*Idioceros sp.*).—This is a serious pest of the mango inflorescence and is widely distributed practically all over the Presidency. The bugs occur in their millions during the flowering period and cause an enormous loss by sucknig up the plant sap. Fish oil rosin soap—the standard insecticide—was effective only against the nymphs and as such was far from perfect. Recently the use of sulphur has attained some prominence as it could be used as an insecticide as well as a fungicide against 'Mildew,' which also occurs frequently on the flower heads,

Exploratory trials were also conducted with DDT and BHC. The former promises to be a specific against these jassids, while, BHC has little or no effect. It is proposed to take large-scale field experiments during the ensuing season.

6. *Pests of betelvine.*—The insecticidal trials under this category constitute an entirely new line of work and the results achieved are of no mean importance.

(*a*) *The Agathi Weevil* (*Alcides bubo, F.*)—Agathi (*Sesbania grandiflora*) is the common standard plant grown for the betelvine and any damage to these trees affects in its turn, the output of the more costly crop, betelvine. Among the few pests, it is subject to this weevil is perhaps the most important and destructive. The adult lays its eggs on the tender shoots of the plant and the grubs, on hatching, bore into the stem eating the tissues. The infestation is often characterized by gall-like formations on the stems and shoots. A few field-scale trials against this pest have indicated that DDT both as dust and spray is capable of exterminating it.

(*b*) *The Agathi plant bug* (*Coptosoma cribraria, F.*).—This is a cosmopolitan pest of legumes and is sometimes particularly serious on Agathi. Trials indicate that dusting with BHC D.025 or Hexyclan causes almost cent per cent mortality.

(*c*) *The betelvine bug* (*Disphinctus politus, W.*).—This dark-coloured bug often occurs in the betelvine gardens especially in the Ceded districts. The adults and nymphs puncture the leaves and suck up the nutrition. The affected spots subsequently develop a blistered appearance and the quality of the leaf is ruined. Mechanical methods like the use of sticky winnows, hand-nets, deterent sprays, etc., were keeping down the pest but to a certain extent only. Recently both BHC and DDT in the form of spray and dust were found to give considerable relief and between the two, BHC spray 0·05 per cent had a quicker knock-down effect.

VIII. Biological Control.

1. *The Fluted Scale—Icerya purchasi, Mask.*—The biological control of the notorious scale—*Icerya purchasi* by its specific predator—*Rodolia cardinalis, Muls.*—Was continued during the year on the Nilgiris and at Kodaikanal under the "*All-India Coordinated Scheme for the control of the Fluted Scale*" as a Post-war Development Scheme.

The incidence of the scale on the Nilgiris was slight to moderate on *gorse* (*Ulex europeaus*), light to stray on *Acacias* and stray to scarce on *citrus*. At Kodaikanal, it was light to stray on *citrus* and *wattles* and stray to scarce *on gorse*. Large numbers of the predatory beetle were bred and released systematically in the infested areas to prevent the possibility of the pest assuming serious proportions. One more host plant—*Petunia* sp. was added to the already existing formidable array of over 100 species.

Breeding and liberation of the predator.—A total of 47,830 beetles was released during the year 28,630 on the Nilgiris and 19,200 at Kodaikanal. About 1,500 beetles were supplied to the Entomologist, Fluted-scale Control Scheme, Government of India, Bangalore, for releases. Besides these, a sufficient stock of the beetles was always maintained in the laboratories to meet any possible demand from other Provinces and States. The breeding was maintained at a high level throughout by using wooden trays for the rearing of grubs and providing artificial warmth to the stocks during the long spells of rainy and cold weather. As previously observed both the pest and the predator thrive well in the field during the warm and dry periods and declined during the rainy and cold season. The other natural enemies, *Rodolia roseipenis*, *Scymnus sp.*, *Stathmopoda melanochra*, the *Cecydomyid* and the *Chrysopid* were also found in the field though in small numbers, but even their combined influence was insignificant as compared with the activities of the specific predator.

Apart from the biological control of the scale, *plant quarantine measures* were rigorously enforced to prevent the inadvertent entry of the pest to the plains from the infested areas on the hills. Two quarantine stations, one at Mettupalaiyam and the other at Shembaganur contined to intercept plants and plant products notified as carriers of *Icerya purchasi* and allowed their transport only after fumigating with calcium cyanide. Of the materials intercepted and fumigated over 1,976 tons of *wattle bark* formed the main item.

2. *Nephantis serinopa, M., control by the Bethylid—Perisierola nephantidis, F., the Eulophid—Trichospilus pupivora, F., and Microbracon* sp.—The two parasite breeding stations at Razole and Narasapur were working in full swing during the year. Over 3 62,100 of Eulophides and 500 Bethylids were bred at Coimbatore and despatched mostly to these two stations to augment their stock and serve as nucleus material for further rearing. The parasite liberations have been going on quite satisfactorily at these two centres. Most of the infested areas have been cleared of the pest, but the more definite indication is the recovery of appreciable numbers of parasites from these areas. Apart from the intensive colonization of the parasites in the Circars, live material was also supplied to different places like Guntur, Salem, Tirunelveli and Coimbatore. Another notable feature under this heading is the recent success achieved in the multiplication of another parasite a *Microbracon sp.* This species was, till now. not quite amenable to Laboratory rearing, but recent trials have shown that it can be easily multiplied on caterpillars of *Corcyra cephalonica*, *Sylepta*, *Dichocrocis* and *Glyphodes*. The rearing technique was perfected and it was possible to despatch about 2,300 cocoons to the different infested areas.

3. *Trichogramma against cotton bollworms* (*Platyedra* sp. and *Earias* sp.).—Four large blocks of Cambodia cotton situated at fairly

long distances were selected at the Central Farm, Coimbatore, and the parasites were colonized in two of them, leaving the other two as controls. Weekly liberations totalling in all 14, were made at the rate of 10,000 parasites per release per acre from November to February. The results were assessed by periodical examinations of the buds during the flushing season and of the bolls during the later stages. The percentage of infestation of the bolls by *Platyedra* during February was 68 in the released plots, whereas it was 75 per cent in the controls. The infestation in the former came down progressively to 41 per cent during March after which there was a slight ascent to 47 per cent by the end of the same month, whereas in the controls it was maintained more or less at the same level. The treated plots gave a yield of 1,158 lb. kapas per acre, while the controls gave 1,033 lb., the difference being 125 lb. Though this variation in yield may not be striking, the quality of the produce collected from the treated plots was found to be uniformly better.

4. *The apple woolly aphis—Eriosoma lanigera, H.*—The incidence of *the woolly aphis* in the Pomological Station, Coonoor, continued to be stray to light probably due to the intensive colonization of the specific parasite—*Aphelinus mali* during the previous year. Sparse attacks by the aphid were noted on the root-suckers of old apple trees and on a few shoots. The parasitised colonies were systematically collected and stocked into the parasite cages, which allowed the egress of only the parasite, confining the aphids to perish inside. The degree of parasitism which was 65·7 per cent during July 1948 increased to 80·4 per cent by January 1949.

5. *The potato tuber moth—Phthorimoea operculella, Z.*—A nucleus stock of the parasite, *Microbracon gelechiae*, was received from New Delhi and multiplied on a large scale, both at Coimbatore and Fernhill. They were released on the Nilgiris in the field as well as in godowns stocked with potatoes. No activity of the parasite was perceptible.

6. *Trichogramma releases.*—Seed material harvested by June 1948 from the irrigated crop was kept in storage for sowing the second crop by September 1948 at the Agricultural Research Station, Nanjanad. The tubers showed 13·8 per cent borer infestation. Large numbers of *Trichogramma* were released in these godowns to study their efficacy in controlling the moths. The released parasites did effective work in keeping down the multiplication of the borers as shown by the entire absence of the adult moths in the stores. The releases were continued on the main crop seed harvested during August and the second crop material lifted during December 1948. Here also there were indications of the pest having been kept in check.

7. *Control of early sugarcane borer Argyria by Trichogramma.*—Refer pests of sugarcane.

IX. Insecticidal Trials.

This item formed one of the major activities of the Section during the year. Considerable attention was devoted to the exploitation of DDT and BHC as agents to destroy crop pests. Remarkable results of a very convincing economic value were achieved in the case of a number of crop pests, accounts of which have already been furnished in appropriate places. The trials were also continued with a number of other patent preparations like hexa-ethyl-tetra-phosphate, nifos-T, parathion products, pyrethex, toxaphene, etc., against a variety of insects. These were more on exploratory lines and as such were restricted to a small scale either in the field or the laboratory. They were found to cause a high mortality on flea and leaf-beetles, aphids, coccids, tingids, aleurodids, etc. The experiments are being continued and the more efficient and cheaper forms will be carried on to the field for confirming the results.

X. Grow More Food.

The efforts of the entire Section practically culminated themselves into rendering a very useful service towards crop and plant protection on a large scale and consequently warding off a good percentage of the loss caused annually to food crops by hordes of their specific pests. The timely availability of the two wonder insecticides DDT and BHC has come in handy against many a serious pest and the recent organization of the Plant Protection Service came in none too soon to transmit the results of research to the agriculturist. A short resume' of the work done is furnished below.

The period under review had the unique experience of tackling successfully a number of major pests attacking mostly food crops. Paddy which happens to be the one of the staple crops had to suffer severely from a few of its insect enemies. The army worm of paddy *Spodoptera mauritia* broke out in all its virulence over the Circars, West Coast and parts of the Tamil Nad and in all about 640 acres of nurseries and 5,500 acres of planted fields were infested. Prompt control measures such as flooding and sweeping the caterpillars were organized. Dusting with BHC D·025, the latest insecticidal treatment was also advocated with a remarkable degree of popularity. An acre requires about 10 to 20 lb. of the chemical costing about Rs. 8 and this expenditure was scarcely grumbled by the ryot since over $2\frac{1}{2}$ tons were purchased and used by them in the Circars alone. The rice grasshopper *Hieroglyphus banian* appeared over about 2,000 acres in the Krishna district and over another 6,000 to 8,000 acres in Malabar. The same chemical BHC D·025 was equally effective against these grasshoppers also and its use is rapidly becoming popular. Another serious pest of paddy, which created such a furore all over the Tamil Nad last year is the paddy jassid *Nephotettix bipunctatus*. Expeditious research was conducted towards the control of this bug. Of the various

chemicals tried, DDT spray at 0·1 per cent concentration was found to give spectacular results at a low cost of Rs. 6 per acre. The pest appeared again this year over 300 acres in the Tamil Nad and was dealt with promptly. An effective remedy by way of dusting BHC D·025 was discovered against the rice bug *Leptocorisa acuta* and this campaign was pushed on over about 100 acres. The cost of treatment is negligible, as it works out to less than Rs. 10 per acre. The damage by the common field rat *Gunomys Kok* was reported to be far more serious than that caused by most of the other pests. Control measures advocated and practised so far, were not convincing and the recent astounding results obtained by the use of zinc phosphide as a poison-bait have practically solved the problem. The mortality of the rodents was so convincing that over 2,000 lb. of the chemical enough to treat 20,000 acres were recently purchased and used by the ryots of the Northern Circars. Apart from the major pests, minor ones such as the smaller grasshoppers, leaf-eating caterpillars and beetles, plant bugs, etc., occurred sporadically in isolated areas and suitable measures were adopted. Crops coming under the category of millets also were subject to the incidence of grasshoppers, the earhead bug, etc., and all these reports were successfully dealt with. In the case of vegetables hundreds of acres of brinjal were protected from its specific enemy, the Epilachna beetle, not to speak of a few other insects which infested this crop. BHC spray has been equally effective against thrips on chillies and garlic and many of the ryots are using it on a large scale on their own account. Another noteworthy feature in the control of pests of vegetables is the remarkable results obtained against cutworms on potatoes and cruciferous crops on the Nilgiris. BHC D·025 practically annihilates these worms and its use is becoming increasingly popular. Besides these, a number of pests on fruit trees, industrial crops like betel vine oil seeds, etc., were promptly attended to. The Research Section at Coimbatore is still busy with finding out new methods of combating the insect foes. Interesting results have been obtained against a number of insects such as the promegranate borer, the ber fruit fly, etc., which were till now defying all our ingenuity and these will be popularised as soon as the tentative results are confirmed.

XI. Civil Supplies Department.

This branch of service comprises of four Regional Assistant Entomologists stationed at Coimbatore, Tiruchirappalli, Madras and Vijayavada with a subordinate staff of about one Assistant for each district. The entire organization is under the technical guidance of the Government Entomologist. The duties of the staff consist of periodical inspection of the food materials at the ports of entry as soon as they are landed and of the material procured locally and held in reserve at the Government godowns, wholesalers and retailers and suggesting as well as conducting suitable methods for the proper preservation of grains whenever necessary. A definite procedure has been evolved to achieve this

object and a short account of the '*modus*' followed is given below: The empty godowns are first throughly disinfested either with BHC D·034 or DDT-33 so as to eliminate the insect population, if any, lurking in the odd corners and crevices. The bags are then stacked in these godowns according to the specifications, leaving plenty of room for aeration, inspection and insecticidal treatment, if required. If there is a suspicion of the stocks having been infested, the external surface of the bag is given a dusting of either BHC D·034 or DDT-33. Cases of bad infestation are promptly fumigated with calcium cyanide and stocks released only after proper aeration and under the authority of the Food Analyst, Madras, to the effect that the material is fit for human consumption. Such stocks are also treated again with BHC or DDT to prevent reinfestation. Foodstuffs, which show a mild infestation, but which could not be treated with chemicals on account of certain inherent factors are recommended either for priority or release or reconditioning before distribution. The major pests of stored products tackled were, *Rhizopertha dominica*, *Sitophilus oryzae*, *Tribolium castaneum*, *Corcyra cephalonica*, *Plodia interpunctella*, etc. The volume of work has increased enormously since the inception of the scheme and a variety of items such as rice, paddy, wheat, milo, semolina, maida, maize, cholam, cumbu, grams, etc., were handled by thousands of tons. Besides calcium cyanide, a few other chemicals like Killoptera, Methyl bromide, etc., were used on a large scale with success. I also visited some of the hulling and blowing installations at Kollegal and suggested a few types of machinery for the milling of paddy and reconditioning of the infested grains. It is unnecessary to over-emphasise on the valuable work turned out by this service as the data in the following statement would amply indicate its enormity ;—

Statement.

Place.	Stocks examined at port in tons.	Stocks inspected in tons.	Stocks reconditioned in tons.	Stocks fumigated in tons.	Godowns disinfested in square feet.	Stocks disinfested in tons.	Priority of stock release in tons.
Coimbatore ..	53,348	4,80,284	1,440	5,355	2,39,737	33,159	..
Madras	2,23,930	1,44,512	105	2,350	5,84,800	28,984	..
Tiruchirappalli.	..	3,50,000	2,596	421	..	50,537	63,036
Vijayavada ..	..	1,57,357	..	3,020	1,02,243	10,525	..
Total ..	2,77,278	11 32,153	4,141	11,146	9,27,780	1,23,905	63,036

XII. Bee-keeping.

This item continued to be one of the main planks in the activities of the section. An average strength of 35 colonies was maintained. Breeding was slack from July to September but improved from

October onwards. The supply of pollen from cholam and honey-dew from the cholam shoot-bug was fair. Cambodia cotton, which is one of the main sources of nectar for the locality failed miserably due to the protracted dry weather from January onwards. A total of 122 lb. 13 oz. of honey was extracted and the maximum recorded from a hive was 10 lb. 8 oz.

1. *Selective breeding.*—The performance of the colonies headed by queens reared from the colonies selected for desirable trails was under observation. Of these selections only one survived and it is interesting to note that this hive has given the highest yield of 10 lb. 8 oz. of honey for the year. The progress of this colony as well as its progeny, if any, will be watched carefully.

2. *Improvement of hives.*—Various devices and adaptations were tried to afford better breeding facilities and consequently improve the hive population. Results were not conclusive since the progress of the colonies was not satisfactory during the period.

3. *Longevity and rate of egg-laying.*—Observations on the longevity of queens recorded a maximum of two years, eight months and ten days. The rate of egg-laying per day varied with the age and season ; the maximum being 511. *Bee-pasturage plants.* Three more plants, viz., (1) *Corchorus capsularis*, (2) *C. olitoris* and (3) *Capparis sepiaria*, were noted as new sources of pollen and nectar.

4. *Bee-enemies.*—The life-history studies on the Reduvid bug *Acanthaspis siva* a predator on bees were continued. Both adults and nymphs are long-lived and capable of preying upon a number of bees during their lifetime. A short account of the information so far gathered is being written up.

5. *Propaganda.*—Batches of the Plant Protection Assistants as well as a few personnel from the Firka Development Scheme and the *Grama Sevak* Sanghs were trained in the subject. Besides these, two batches of students of the Madras Forest College, a batch of women teachers undergoing training in ' Home Science ' and one probationary District Agricultural Officer were given the necessary details of the subject. Demonstrations were held for the B.Sc. (Ag.) students of the Coimbatore as well as the Bapatla Colleges. Arrangements were also made to supply apicultural requisites to various institutions and private parties. The comb foundation mill was found to serve a very useful purpose, since this Section has practically become the main source of supply of the sheets not only for this Presidency but to other Provinces as well.

XIII. Earthworms.

Earthworms were reported to occur in paddy fields at the Agricultural Research Station, Ambasamudram, conferring immense benefit by way of increasing the soil fertility. A study of the life-history and habits of the forms occurring at Coimbatore, Ambasamudram, Aduthurai and Tirurkuppam was in progress. All these

appear to belong to the group *Megascolecidae* and seven samples were isolated. The local variety *Pheretima* was found to breed satisfactorily, while the response was poor in the other cases. The egg-cocoons of the local species were detected in the soil. The period for hatching varied from 5—12 weeks. The worms were found to develop the clitellum in the course of 10—30 weeks after hatching and commence egg-laying in about 14 weeks in some cases. They are more abundant in soils rich in organic matter and less so in sandy soils.

XIV. Systematic Work.

Attention was devoted for the collection and sorting of insect specimens into their respective orders and families. Members of the Section were also initiated in the study of particular groups for intensive study. A number of families like *Pyralidae*, *Psychidae*, *Pentatomidae*, *Coreidae*, *Aphidae*, *Scoliidae*, *Sphegidae*, *Syrphidae* and *Agromyzidae* received attention. A few specimens of parasites, moths, beetles and earthworms of doubtful identity were sent to Specialists for indentification. Four species of *Bruchids*, *a Reduviid* and a *Tortricid* moth were incorporated in the named collections after being indentified by the Specialists.

XV. Schools of Research.

The work of the two Research Fellows under the scheme of School of Research initiated by the Indian Council of Agricultural Research, were supervised. Cataloguing, indexing as well as the review on *Braconidae* were completed by Sri M. G. Raja Varma. The preparation of similar work on *Thysanoptera* was kept in abeyance subsequent to the appointment of Sri A. R. Seshadri, as Assistant Entomologist, Singampatti.

XVI. Fumigation.

Over thirty-four packets of seed and plant material and a number of consignments of tamarind, were either fumigated or examined and passed and the necessary phytosanitary certificates issued, for export.

XVII. Training.

About sixty subordinates posted for Plant Protection work and one probationary District Agricultural Officer were given a thorough training in the activities of the Section.

XVIII. Exhibition.

The Section took part in most of the Exhibitions, held in different parts of the Presidency, the important ones being the All India Khadi, Swadeshi and Industrial Exhibition, Madras, the Gandhi

Basic Educational Conference, Perianaickenpalayam, the Annual Flower Show, Ootacamund. A comprehensive exhibition pertaining to the activities of the Section were got up during the College Day Week, 1948. The Section was visited by the Hon'ble Ministers for Agriculture and Industries, a number of M.L.A's. and prominent citizens.

XIX. Visitors.

His Excellency the Governor of Madras visited the Section during June 1949 and exhibited a very keen interest in progress of the Section. Honorary visitors Sri. K. Venkataswami Nayudu Sri V. C. Palaniswami Gounder and Sri C. Subramaniam visited the Section during the year.

XX. Publication.

Short papers on the Food Crisis and its Solution, the Cardamom thrips as well as a number of popular articles for the different journals were prepared and sent.

STATEMENT SHOWING THE TOTAL NUMBER OF SANCTIONED POSTS OF OFFICERS AND STAFF IN THE OFFICE OF THE GOVERNMENT ENTOMOLOGIST, AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE, COIMBATORE, AS ON 30TH JUNE 1949.

	Number of sanctioned posts.	
	Temporary.	*Permanent.*
I. Madras Agricultural Service.		
Government Entomologist		1
Assistant Entomologists	1	2
II. Madras Agricultural Subordinate Service.		
Assistants in Entomology	1	10
Fieldmen	1	4
III. Madras General Subordinate Service.		
Laboratory attenders	1	4
Insectary attender		1
IV. Madras Ministerial Service.		
Lower Division Clerks	1	2
V. Madras Inferior Service.		
Peons		6

LIST OF OTHER TEMPORARY POSTS LOCATED IN THE DISTRICTS.

Rodolia Breeding Scheme.	*Number.*	*Headquarters.*
I. Madras Agricultural Service.		
Assistant Entomologist	1	Fernhill.
II. Madras Agricultural Subordinate Service.		
Assistant in Entomology	1	Kodaikanal.
Fieldmen	3	Fernhill.
	2	Kodaikanal.
III. Madras Ministeriol Service.		
Lower Division Clerk	1	Fernhill.
IV. Madras Inferior Service.		
Peon	1	Fernhill.
PLANT QUARANTINE SCHEME.		
I. Madras Agricultural Subordinate Service.		
Plant Quarantine Inspector	1	Shembaganur.
Do.	1	Mettupalayam.

COIMBATORE,
1*st August* 1949.

S. RAMACHANDRAN,
Government Entomologist.